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Artificial, applied and human intelligence

Peter Middleton

COMMENT

I was recently asked if I had used ChatGPT to help generate an article. I definitely had not, and was rather insulted that the question had been asked. But it triggered the need to find out more, most notably about how fast I was likely to be made redundant by machine-generated magazine content.

A Google search tells me that ChatGPT – developed by OpenAI, another company involving Elon Musk – is "an AI chatbot that uses natural language processing to create humanlike conversational dialogue. The language model can respond to questions and compose various written content, including articles, social media posts, essays, code and emails". Impressive and worrying for my future work prospects!

But then I read that it is "similar to the automated chat services found on customer service websites, as people can ask it questions or request clarification to ChatGPT's replies." I don't I know anyone who doesn't intensely dislike automated customer service calls.

GPT is an acronym that stands for generative pre-trained transformer, implying that the system is 'trained' in advance to improve the responses it gives. This is done through human feedback that ranks the best responses. The system is described as using state-of-the art natural language processing (NLP) and a neural network to generate responses to input questions without the need to be explicitly told what the answers are or where to look for them.

According to an article in the Databricks website (www.databricks.com): "We are in the golden age of data and AI. The unparalleled pace of AI discoveries, model improvements and new products on the market puts data and AI strategy at the top of conversations across every organisation around the world. The next generation of winning companies and executives will be those who understand and leverage AI."

Apart from the impressive GPT chatbot, AI is the technology underpinning the automation of image and speech recognition; self-driving cars; medical symptom and image analysis; security surveillance for unusual behaviour; fraudulent financial transactions; market trends and power grid control and stabilisation.

It is said to be a dominant new technology with the potential to automate, maximise efficiency and transform many industries. On the down side, though, it comes with risks, including misinformation, fake news and deepfakes; privacy breaches; bias and discrimination. With respect to jobs, AI is predicted to make some 85-million jobs obsolete between 2020 and 2025, but it is also expected to create 97-million new jobs.

The biggest threat, however, is being called 'singularity', which is the point at which AI surpasses human intelligence and ceases to be under human control, which some believe could occur within the next decade.

In an interview with BBE's Richard Gundersen published in this issue, he says: "We see VUMA as a programme with AI capabilities, which I prefer to call 'applied intelligence', because the intelligence is not artificial. VUMA was created using our experience of real ventilation systems. The software incorporates our engineering intelligence with respect to heat flow for mine cooling requirements and how that can be best managed," he explains.

Two things struck me immediately. First, AI is not new. As a student some 40 years ago, some of my colleagues were working on expert systems. I guess these might have been of the 'rule-based' type, but the point of them was very similar to the descriptions we have for AI today. "Expert systems are computer programs that simulate human expert thought processes to solve complex decision problems in a specific domain." And if the use of 'artificial' neural networks is a defining feature of artificial intelligence, modern-day expert systems also do, so they are not very different.

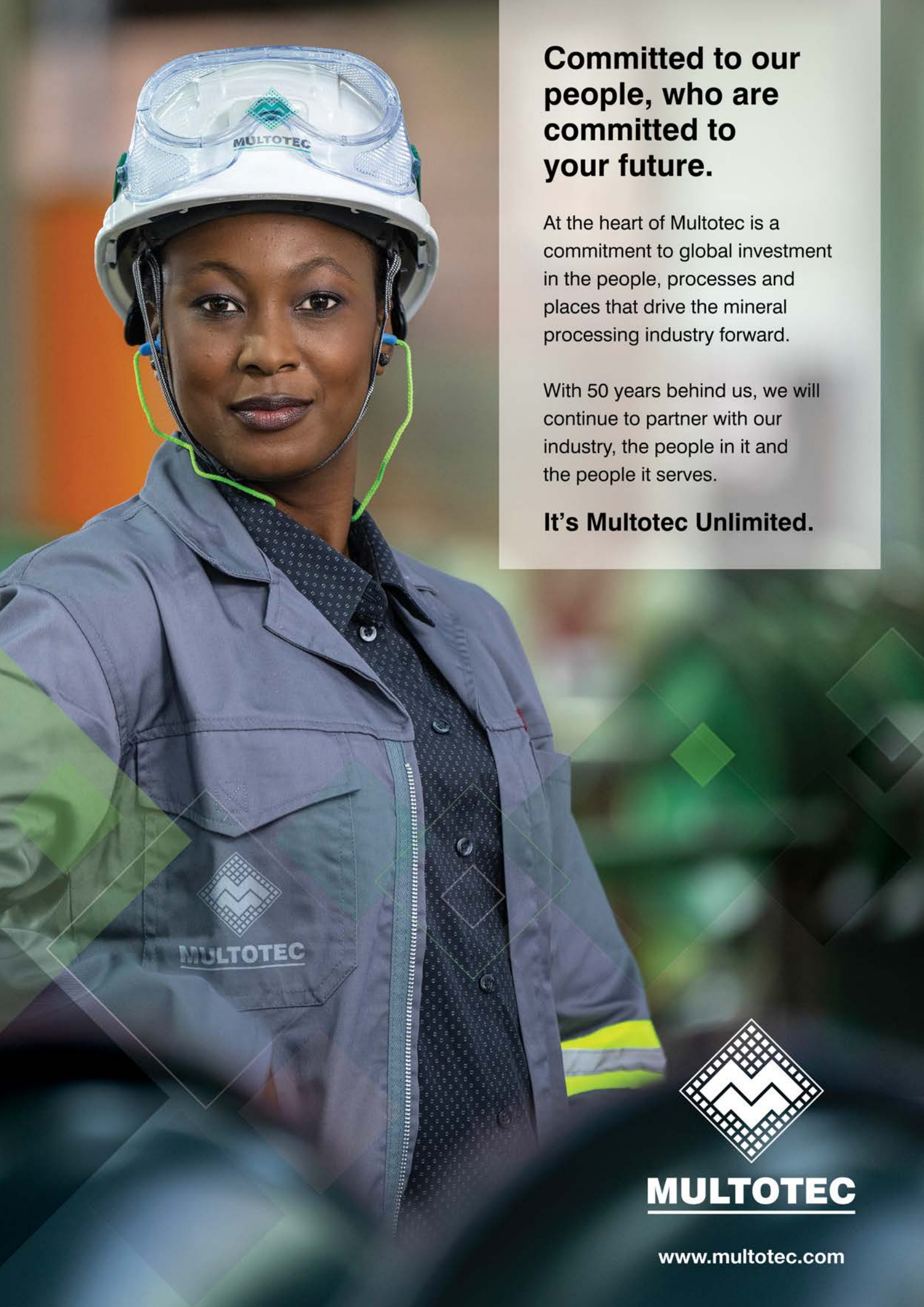
Also, though, using the word 'applied' instead of 'artificial' reinforces the importance and limitations of human input into AI systems. All machines are created by humans, no-matter how 'intelligent.' Some may argue that this may not always be true, but the huge amounts of data being collected and used in these systems is generally generated from human activity and/or creativity.

And we know that human activity and creativity is not all good. Many of the potential 'fears' we associate with AI are human driven: misinformation is used to manipulate who we vote for; people use fake news to divide us and deliberately cause unrest; and in so many ways, our preferences and lifestyles are being manipulated into making other people rich.

When used to advance our collective knowledge; to use our resources more efficiently; to lower impacts on the environment, to reduce poverty and to genuinely improve the quality of life, AI is likely to be overwhelmingly positive.

But because there are intelligent humans who see only winning, power, profit and their own insatiable needs, AI is certain to need effective and thorough regulation.

And as for my own fears about ChatGPT, there are already a huge number of human writers far better than I will ever be.



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Power-to-X, green chemicals and engineering a sustainable tomorrow

Nithesh Mohun, Business Development Lead for Green Chemicals at thyssenkrupp Uhde Africa, talks about the benefits of green ammonia, Power-to-X and sustainability.

Established in South Africa in 1959, thyssenkrupp Uhde Africa is the local subsidiary of thyssenkrupp Uhde GmbH. "Underpinned by a global footprint and local presence, we are a market-leading technology, engineering, construction and service partner for industrial plants and systems," says Nithesh Mohun of thyssenkrupp Uhde Africa.

Combining over 100 years of global experience with over 63 years of local African know-how, thyssenkrupp Uhde Africa is a specialist provider of a range of advanced chemical technologies and integrated, environmentally friendly EPC (engineering, procurement and construction) solutions and services. "We provide the full range of services for fertiliser, petrochemical, oil and gas, and green chemicals," says Nithesh Mohun.

Power-to-X and green chemicals

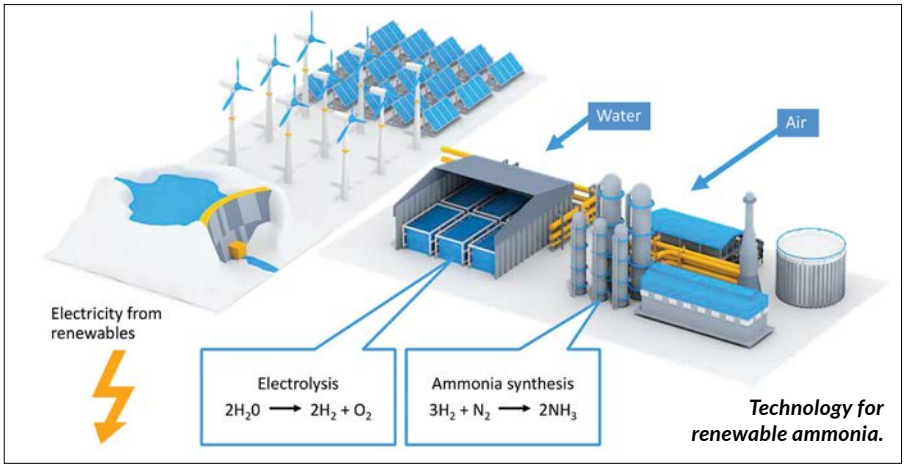
The starting point of the green chemical value chain is hydrogen. "Hydrogen is viewed as an enabler of the green chemicals value chain. Traditionally, hydrogen is produced using the fossil fuel-based steam-methane (CH_4) reformation process. While this process sets the price benchmark for competitive hydrogen production, its main drawback is the fugitive production of greenhouses gases, primarily carbon dioxide."

"The sustainable alternative to fossil fuel-based hydrogen is green hydrogen. This is produced by splitting water into pure hydrogen and pure oxygen through the application of renewable electricity in a process known as electrolysis. An electrolyser is the equipment that uses electrolysis to split water (H_2O) into its two elemental gases, hydrogen (H_2) and oxygen (O_2). The hydrogen produced can be classified as 'green' as there is little to no carbon dioxide released during the electrolysis process or in the process of producing the electricity used," he explains.

"By leveraging the transformative potential of green hydrogen, thyssenkrupp Uhde is championing the development and implementation of green technologies. This includes technologies to produce green ammonia, green methanol, sustainable aviation fuels and green fertilisers, amongst others. In industry, this is commonly referred to as Power-to-X applications, where X represents a hydrogen

Green ammonia has significant advantages over hydrogen in that it is easier to store and handle, and is also seen as a safer way to transport hydrogen itself.

derivative or any of the above chemicals," Mohun adds.He highlights a diagram showing the integrated nature of thyssenkrupp Uhde's solutions that use renewable power to produce Power-to-X chemicals. "We offer holistic and customised solutions using proprietary and seamless technologies that are based on delivering best possible productivity and cost performance," he says, adding, "These are modular solutions that enable decentralised production of green chemicals, and modularisation affords the plant owner faster delivery, safer work environments and appreciable cost savings."



Technology for renewable ammonia.

Ammonia as a hydrogen carrier

Ammonia or NH_3 consists of one part nitrogen to three parts hydrogen and is typically made using the Haber-Bosch process, which combines pure nitrogen from the air with hydrogen in a high temperature reactor.

The development of this process was one of the most important in human history, having prevented mass starvation when supplies of the natural nitrogen-rich fertilizer, guano, began to run out towards the end of the 19th century. And it continues to be the key chemical for manufacturing fertilisers that are essential for high-yield food production for an ever-increasing global population. Ammonia is currently also in the spotlight for its potential as a hydrogen storage medium, or green fuel. The maritime industry is expected to be an early adopter of green ammonia to replace diesel in marine combustion engines, although the engines needed for this are still in the early phases of development. Mohun continues: "The use of ammonia as an energy carrier and means of transporting hydrogen has many advantages. Firstly, it is more energy-efficient to transport than hydrogen. Secondly, ammonia can be used to transport larger amounts of energy over long distances in less space. Thirdly, we already have a globally established infrastructure for transporting ammonia that is safe and efficient.

"Green ammonia is, therefore, increasingly being produced for export markets for consumption in Europe and Asia. "South Africa, with its favourable solar and wind profiles, has the potential to produce green ammonia very competitively," Mohun adds.

Driven by sustainability

thyssenkrupp has a strong sustainability focus. "Prioritising our climate and the need to create a liveable planet for ourselves and future generations is what drives us to create innovative and sustainable technologies. But we do not just talk-the-talk, we also walk-the-walk. The non-governmental organisation CDP (formerly Carbon Disclosure Project) has, many times over, named thyssenkrupp as one of the world's best companies in climate protection," he points out. "thyssenkrupp Uhde Africa has been serving the production needs of clients across the African continent since 1959. Our project successes and track record across the continent is attributed to our global expertise, local knowledge and service excellence. We know Africa. With our green technology portfolio, we aim to become the leading EPC and clean technology solutions provider in sub-Saharan Africa (SSA)," he concludes.

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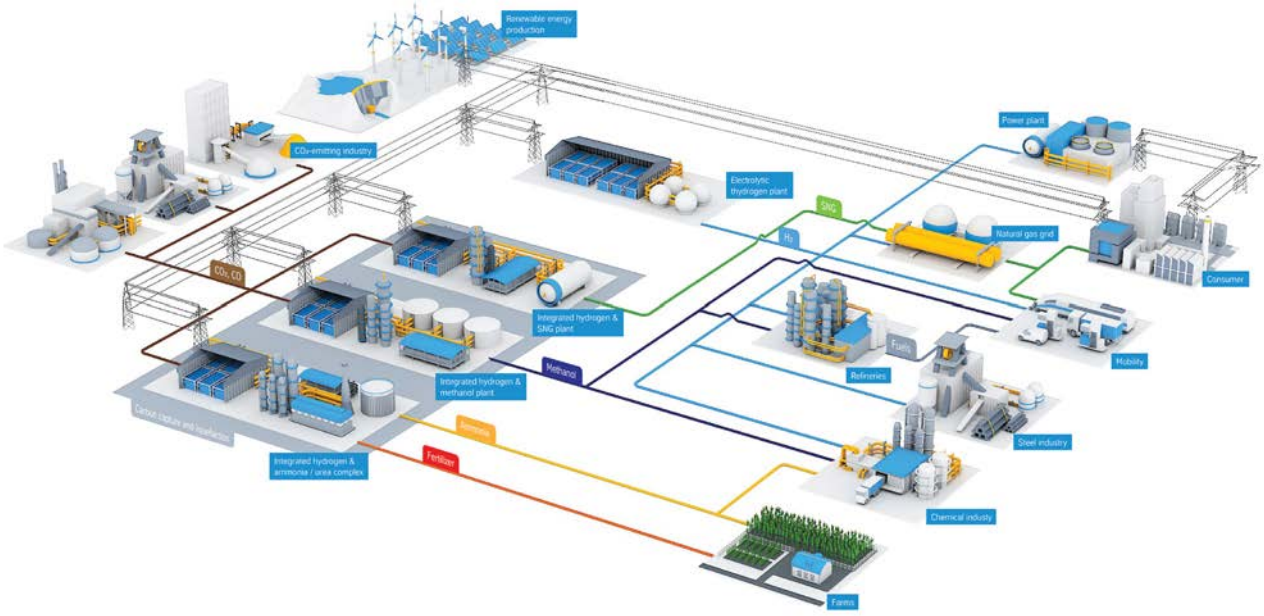


thyssenkrupp Uhde's proprietary know-how, developed over nearly a century in the industry, enables the company to deliver safe, efficient and environmentally sustainable Power-to-X solutions – including but not limited to green ammonia, green methanol, sustainable aviation fuels and green fertilisers.

Lubrication – is it really that important?

Eddie Martens, business development manager for maintenance products at SKF South Africa, unravels the mystery of lubrication which, he assures, if applied based on the '5 Rs' taught to him during training, will deliver improvements in uptime as well as a visible cost saving.

I have been lucky enough to travel across the country to do presentations at several industrial plants, specifically on our SKF maintenance products. During these travels, we have encountered numerous surprising fitment, removal, and alignment methods. Overall though, standard practices when it comes to lubrication have been the most eye opening. When we consider that 50% of all bearing failures are due to incorrect lubrication or contamination, we should expect alarm bells to be ringing at many industrial sites. But unfortunately, this is not the case.

Any lubrication, be it oil or grease, remains a consumable product and therefore does not receive the attention it deserves. Remember, consumable products include items such as rags and cleaning fluids and, because of this, any cost savings are be looked at as an overall saving on all consumable items rather than trying to reduce consumption on specific consumables. The reaction we receive when a calculation is done on the exact costs of lubrication products alone is therefore usually one of shock. A small plant we recently visited uses in the region of 80 t of grease a year, but if you look at the lubrication methods being followed, you can understand why.

Walk into any lubrication store and I can almost guarantee the only drum standing open is a grease or an oil drum. The standard transfer method for oil will be the empty 2.0 ℓ cold drink bottle closest to hand, or a 5.0 litre container that can be used to transfer anything from distilled water to petrol to oil to thinners. Tell me I'm wrong!

The basic understanding of most technicians/artisans is that you fill a bearing with grease until clean grease comes out the other side of the unit. I joke that I like this method because it enables us to sell more seals as those seals are definitely damaged! The other fallacy is that grease is grease. Our mining community believes in EP2 grease for every application from door hinges to fan applications. To summarise, below are some key problematic misconceptions that ought to be addressed.

Designed to supply from one to eighteen lubrication points, SKF TLMP series multi-point lubrication systems feature pluggable outlets and are easy to install and program via a keypad with an LED display.

- Grease is grease and can be applied in any application.
- A bearing must be full of grease to be properly lubricated.
- Contamination is not an issue provided it is kept to a minimum.
- Grease is a consumable item and therefore costs and consumption need not be controlled.

Grease is grease

So long as a bearing or unit has grease in it, it is lubricated and will not fail. Correct? A universal grease is all that is needed; after all, why call it a universal grease if it cannot be used universally?

Basic understanding needs to start with how grease works. Everyone knows what it looks like – it's that messy stuff we get all over everything when working with it. That is what lubricates our bearings, or is it?

When we look at a data sheet for grease, several terms are listed including 'Thickener', 'Base Oil Type', etc. If there is no understanding of these terms then grease will forever remain grease.

Starting with a basic test, we would put some grease on a piece of paper. What would happen? A film would start appearing around the grease. That is the base oil 'leaking' out of the thickener/soap.

If we were to warm that grease up, the rate of 'leaking' would increase as the thickener loses its retention properties. From this we

SKF Battery-driven TLGB-series grease guns include integrated grease meters to help prevent over- and under-lubrication.

can draw a conclusion – as the thickener is heated up, the faster the oil will leak.

The trick here is to remember that the thickener does not lubricate the bearing: the oil does. If we take this further, it stands to reason that if we have a bearing designed to run at a high temperature the oil will 'leak' from the thickener at a much higher rate. If we run a car's engine with several oil leaks, it will eventually fail because there will no longer be any oil to lubricate the motor. Well, guess what? The same thing will happen to the grease. To avoid this we must design a grease that will 'leak' at a slower rate under higher temperature. Now things become more complicated because the oil needs to leak enough to lubricate but not so much that it runs out or separates completely from the thickener.

Every grease is designed to perform to a specific set of parameters and conditions. All greases may overlap in certain areas when it comes to operational temperatures, but it is important to keep within those parameters. This leads to the next problem – selecting the correct grease for the application. If we do not know all the operating conditions under which the bearing or unit is expected to perform, we could end up recommending the incorrect grease for that application.

This is why it is so important not to recommend a grease based on one a customer is currently using. It could be that they have been using the incorrect grease from the start and, if a similar grease is used, all that will happen is that the problem will persist. This is before we take into consideration the possibility that the two greases may be incompatible. Remember, greases are a mixture of chemicals that could well react very differently to each other if mixed. It is very important to know which chemicals can safely be mixed and which cannot. For this reason, always consult an expert if you are unsure. In the MaPro catalogue there is a chart showing which thickeners and base oils are compatible and which are not.

Thickener, as the name implies, adds density to the grease. Some greases may be thick and tacky whilst others may be almost oil like in consistency. There is an international grading standard all greases conform to. It is known as the NLGI (National Lubrication Grease Institute) consistency class and all greases fall into one of the following classes starting at 000, being the thinnest grease, up to 6, which would be the thickest.

Added to the mix are additives that could be incorporated into the grease to enhance its performance. Already, I am sure that it is becoming more obvious that grease is not just grease. Much more in-depth information can be obtained through a course in Tribology.

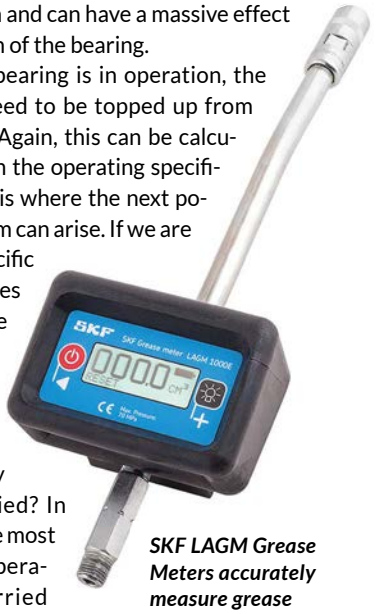
How much grease should a bearing have in it?

As stated previously, the consensus in the marketplace amongst technicians and artisans is that a bearing or housing should be filled with grease until it exits the other side of the bearing in a clean form. By doing this we are purging all the old grease out of the bearing and ensuring there is only clean grease in it. To understand why this is wrong we first need to look at some of the terminology around a bearing. It consists of the following components: an outer race; inner race; cage; and rolling elements.

When the bearing rotates, the rolling elements must also rotate. If the bearing is filled with grease, the rolling elements lose their ability to rotate and will then slide, causing them to heat up in the same way that your hands heat up if you rub them together. This is due to friction, and friction on the rolling elements of a bearing will cause the bearing to fail in a shorter time.

A calculation can be done for each bearing in every operation to ensure the correct amount of grease is applied. It is known as the initial fill and most engineers can calculate this quantity. Alternatively, there are web sites with calculators for doing this. This is a vital first operation and can have a massive effect on the lifespan of the bearing.

Once the bearing is in operation, the grease will need to be topped up from time to time. Again, this can be calculated based on the operating specifications. Here is where the next potential problem can arise. If we are told that a specific bearing requires 4.0 g of grease every second day, how do we know that the exact quantity is being applied? In the work place most lubrication operations are carried out manually using grease guns. With a gun, the grease is applied in the form of a few pumps of grease and human error comes to the fore. What exactly is meant by "a pump?" It is a stroke of the grease pump's actuating lever, but is it a full stroke? Is my



SKF LAGM Grease Meters accurately measure grease discharge by volume or weight.

SKF System 24 gas-driven single point automatic lubricators are supplied filled with a wide range of high performance SKF lubricants. Tool-free activation and time-setting allow easy and accurate adjustment of lubrication flow.

stroke of the lever the same as the next person's? How old is the grease gun? Have the parts worn to the extent that they no longer deliver the same amount of grease? Has any grease, in fact, been delivered?

This applies to manually and pneumatically operated grease guns. Lubricators have been told that each operation of the air pump delivers a certain amount of grease, and they therefore need only count the number of pumps of the air gun to determine the exact amount of grease that has been delivered. In a recent lubrication audit a lubricator proudly proclaimed, after being asked by one of the auditors how much grease he had used carrying out his duties that day, he was sure he had used 36 kg of grease. This was impressive as he only had a 20 kg drum of grease, which was not replaced during the observed period. In fact, when the drum was opened it was found to be half full. This meant that every lubrication point had been severely under lubricated.

Here, the use of grease meters could have been applied to all the lubrication equipment to determine the exact amount of lubricant decanted. Lubrication points should be clearly marked with the grease type, amount, and frequency of lubrication. One method of doing this would be to use colour coded labels that had the details for that grease point on them, that is, type of grease, amount of grease and the frequency of lubrication.

Contamination

One definition of contamination is 'the action or state of making or being made impure by polluting or poisoning.' The use of the word 'poisoning' I thought was very apt. If you poison drinking water, there is a potential for people to become very unwell or die. Your machine will eventually die through contamination if it remains unchecked.

There are a number of ways of contaminating lubrication. As discussed above, cross contamination of different types of grease can lead to failures. Dust contamination, water ingress or other forms of liquid are also common. This is the reason for units having seals and these sealing systems can be very complicated. But no matter how much money is invested in the 'best' sealing system, if it is being filled with contaminated grease or oil, the bearing will fail.

As outlined above, when a bearing is filled with grease, the lubrication is being carried out by the base oil being 'leaked' into the space between the surfaces of the bearing. Just how thick is this oil film? To gain a better perspective, consider a grain of dirt 10 µm in size. Can this be seen with the naked eye? No. A human hair is, on average, 50 µm thick and would be visible to the naked eye. The lubricating film between the contact surfaces being lubricated, when the unit is at full operating temperature, is between 0.1 and 1.0 µm thick. That 10 µm grain of dirt will push the lubricating film away with ease.

The best illustration of what this can cause is in a simple picture. Consider two identical bearings. They have been manufactured to the same specification in the same factory, but there is one critical difference between them – one will produce 1 000 hours of service whilst the other will provide 10 000 hours service. Why is this? The fitting and lubrication methods used and contamination. These three factors relate to 66% of all bearing failures. As a customer, I would most certainly prefer having to replace my bearings every 10 000 hours as opposed to 1 000 hours.

Also remember that contamination can also be caused by mixing two different types or even makes of grease. While the claim may be made that the grease will perform in the same manner as another type of grease, the components that make up the greases may differ significantly. Even though the basic thickener and the base oil may be compatible, there are certain additives that may react with other components. If a factory is using three different types of grease, there should be three grease guns, clearly marked for each grease type.

Grease is a consumable – disregard the costs

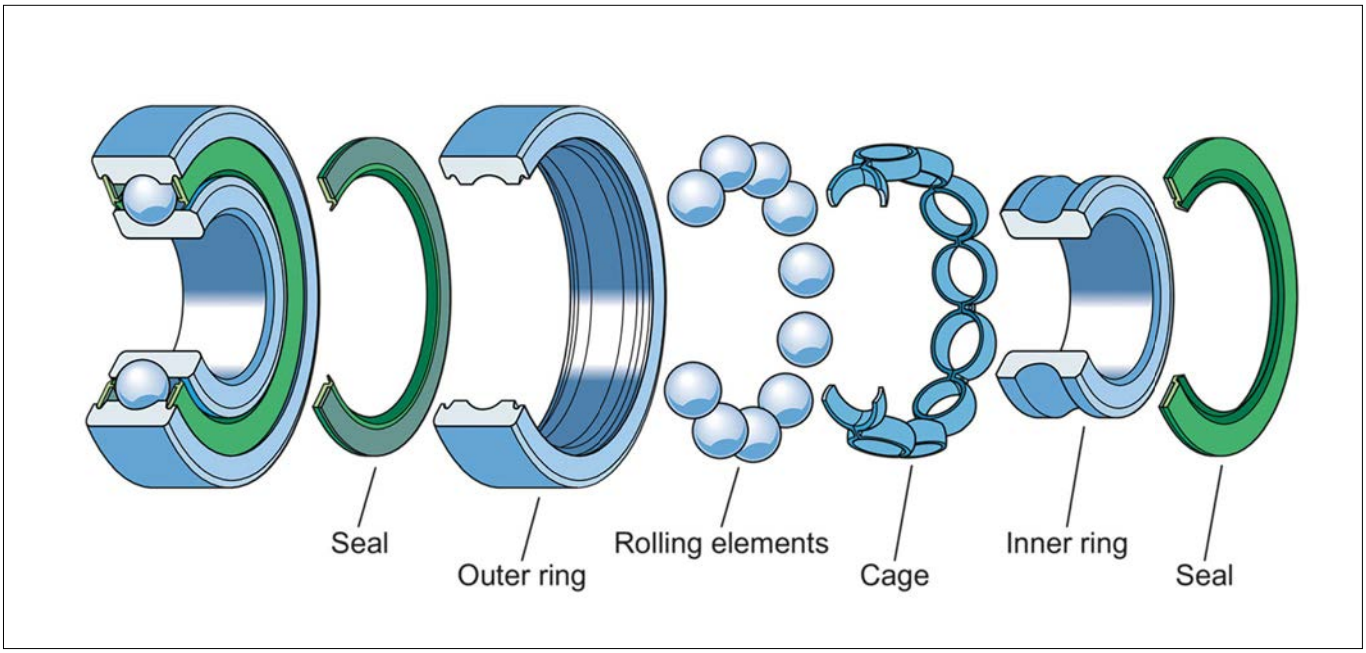
Many customers do not realise how much of a saving can be made by controlling the consumption of grease. An even scarier observation is that most companies are not sure of their exact spend on lubrication. On bigger plants this can, and has been proven to, run into millions. In this age of cost cutting and cost saving, one of the most obvious ways of saving costs is being ignored. Working smart with lubrication and grease purchases and how they are used in the workplace can notably reduce costs; in some cases, by up to 50%.

The use of automatic lubricators, multi-point lubrication systems, lubrication route planning and training can lead to massive savings in the long term.

In the training I received we were taught the '5 Rs' of lubrication, which I now call the 'Lubrication Mantra'. Here they are: Use the Right lubricant; the Right quantity; at the Right time; at the Right point; and using the Right method.

If this mantra is followed, lubrication should no longer be a mystery and there will be an improvement in uptime as well as a visible cost saving.

www.skf.com



A bearing consists of the following key elements: the outer race, the inner race, the cage, the rolling elements and the seals.

Sustainability through optimisation

The LaserGas iQ² analyser is the first to measure up to four gases (O_2, CO, CH_4, H_2O) and temperature, which eliminates the need for multiple units for combustion analysis.

Stephen Scholtz of RTS Africa, the approved distributor and service agent for NEO Monitors in sub-Saharan Africa, argues that sustainability involves more than simply monitoring and reporting on emissions. It requires understanding and control of each step of a process, along with prolonged maintenance and support.

"Sustainability involves more than monitoring and reporting emissions. Understanding and controlling the entire process chain is crucial for prolonged maintenance and support. Through optimisation, we can directly increase product quality and profit margin; however, an often overlooked, secondary effect is the reduction in pollutant generation," begins Stephen Scholtz of RTS Africa.

"With regard to combustion, one of the most important industrial processes for providing heat and power to operations, the primary goals of plant operators are fuel efficiency and safety. Optimising the combustion process not only increases both these factors, but the generation of pollutants such as COx and NOx is also greatly reduced," he says.

Gas analysers based on Tunable Diode Laser Absorption Spectroscopy (TDLAS) have been used for many industrial process control and emission monitoring applications. However, the use of TDLAS for combustion analysis has always been a challenge. Balancing operator goals requires carbon monoxide (CO) measurements to be made across a high dynamic range. PPM readings need to be measured with high sensitivity for clean combustion while safe operation relies on accurately monitored percentage CO levels. Gas concentration is determined by scanning a laser with a known wavelength across a spectral region where the gas to be measured absorbs light. The laser is directed across the column of gas towards a photodetector where the light emitted from the laser is processed and monitored. The gas concentration is calculated using a function based on absorbed light and known process parameters, such as optical path length, temperature and pressure. With the gas' light absorption capabilities proportional to the concentration, less light received by the photodetector translates into a higher concentration of the target gas. Scholtz elaborates on the principle TDLAS: "In TDLAS, the wavelength of a laser is scanned across a narrow spectral region where the gas of interest absorbs light. As the laser light propagates through the gas, a fraction will be absorbed, which causes a dip in the transmission that can be quantified by collecting the laser light on a photodetector and monitoring its response. As the name implies, laser absorption spectroscopy measures the characteristic absorption profile (or transmission profile) of a gas from which the concentration can be calculated given knowledge of the measurement conditions (optical path length, temperature, pressure, etc).

Considering the abovementioned narrow spectral region, all gases have absorption lines at different wavelengths. When implementing TDLAS, it is crucial to select an absorption line that is not shared by gases that may present in the process stream. When scanning for CO there are several available absorption regions to choose from. However, each has its own limiting characteristics. Dr Peter Geiser, *et al*, 2019 writes: "While the band around 1.5 µm is too weak to achieve the desired sensitivity, the band around 4.6 µm is too strong and thus limits the upper boundary of the measurement range. This leaves the 2.3 µm band, where not only methane (CH_4) has strong absorption bands but some water vapour (H_2O) absorption lines are very strong at high temperatures."

To combat this challenge, NEO Monitors has developed a single combustion analyser, combining a new signal processing technique with two lasers in a single compact unit. One laser is responsible for measuring O_2 and temperature, with the additional second laser measuring the remaining process stream constituents: CH_4, CO and CO_2. In addition, the ability to monitor CO levels at the high dynamic range has allowed the inherent benefits of general TDLAS to be used fully across burner applications. The in-situ, cross stack measurement, when compared to extractive sampling, is superior for accurately representing the entire combustion zone, while fast response times are essential for detecting rapid concentration changes in highly dynamic combustion processes.

Unlike alternative technologies, TDLAS technology can continuously measure target gases without the presence of other gases, providing critical feedback on safe/unsafe operation while ensuring optimum air-fuel ratio control.

"NEO Monitors' LaserGas™ iQ² can therefore provide cost-effective and reliable fine control of the entire combustion process, contributing to a reduction in unwanted emissions and, most importantly, a safer environment capable of operating well into the future," concludes Stephen Scholtz. RTS Africa is the approved sub-Saharan Distributor and Service Agents for NEO Monitors.

www.rtsafrica.co.za

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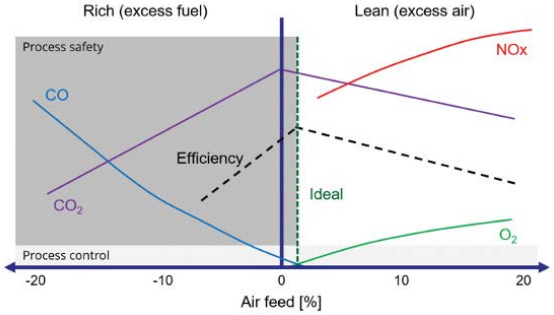


Figure 1: A combustion optimisation diagram. Optimising the combustion process not only increases fuel efficiency and safety, but the generation of pollutants such as COx and NOx is also greatly reduced.

Microfine filtration boosts fuel quality, reduces equipment failure

The path to contamination-free fuels relies on minimising contamination prior to use. Craig FitzGerald from ISO-Reliability Partners introduces his microfine filtration solution.

Microfine filtration systems from ISO-Reliability Partners include a stainless steel desiccant air breather that absorbs moisture, as well as radial and depth filtration, with around 6 000 times the filtration media when compared to market competitors.

The breather is filled with thousands of desiccant silica gel beads designed to absorb moisture from the air and tank headspace. These change colour when filters need to be serviced. The breathers are fitted on diesel and oil bulk holding tanks, gearboxes, and lube and hydraulic systems to capture large volumes of moisture and particulate contamination at low cost. "This makes the technology not only feasible, but also highly recommended in comparison to common options on the market," says Craig FitzGerald from ISO-Reliability Partners. Its microfine filtration solutions and wear particulate analysis offerings were the result of FitzGerald identifying fluid contamination as the initial driver behind the vast majority of equipment failures.

According to the South African Bureau of Standards SANS 342:2016, the maximum water content allowed in automotive diesel fuel is 350 mg/kg, with total contamination of particulate matter being 24 mg/kg. The US government has a stricter specification of 10 mg/l (about 12 ppm) for particulate matter. However, neither specification addresses the critical issue of particle size.

While most fuel filters recommended by engine manufacturers have a nominal pore size of 10 µm, studies reveal that the critical particle size for initiating significant abrasive wear in rotary injection fuel pumps and in high-pressure fuel injection systems ranges between one to seven microns.

However, as designs to reduce emissions result in higher rail and injector pressures, the tighter clearances have less tolerance for solids, moisture and impurities in the fuel.

As a result, some engine manufacturers now specify filters with pore size as low as 2.0 µm. "The problem is that moisture and dust particles that can pass through a two-micron filter can easily damage the injection parts of a diesel engine. The present standard is therefore not strict enough," highlights FitzGerald.

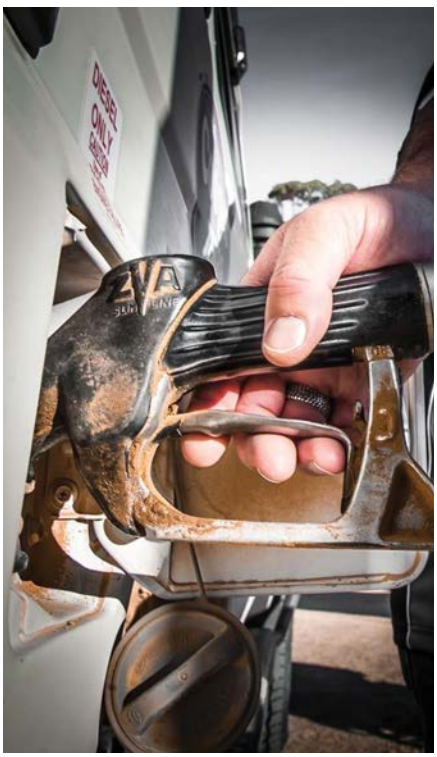
SANS 342:2016 has made strides towards reduced engine failures with the inclusion of ISO 12156-1 for fuel lubricity, an essential assessment. "It must be noted that testing is done at the refining stage, yet contaminants continue to enter well after the fuel is given the greenlight for quality," notes FitzGerald.

ISO-Reliability Partners is an OEM of class-leading microfine oil filtration solutions, vacuum dehydration systems, automated water removal for compressed air, and high efficiency industrial air scrubbing. Its expertise combines the sciences of lubrication, filtration, and tribology.

www.iso-reliability.com

***ISO Reliability's microfine filtration results** (right) **versus competitors** (left).*

Moisture and dust particles will quickly cause damage to the injection parts of a diesel engine.



Contamination-free fuel is critical for optimal performance and efficiency.

Air filtration for dusty sites

Gordon Postma, Field Services sales manager for Booyco Engineering, explains how Sy-Klone clean air solutions achieve higher standards of filtration where dust levels are severe.

Germiston-based Booyco Engineering is now a distributor for Sy-Klone International's air filtration technology.

Well known for its specialised mobile HVAC solutions, Germiston-based Booyco Engineering is now a distributor for Sy-Klone International's air filtration technology. According to Booyco Engineering's Field Services Sales Manager Gordon Postma, this brings a range of exciting products to its local customers. The Sy-Klone offerings include enclosed cab filtration, air precleaning for engines and high efficiency air filtration for heavy equipment.

RESPA cab air quality systems, available from Booyco Engineering, ensure fresh and recirculated clean air and include a pressure/CO_2 monitor making these ISO 23875 compliant.

"We can offer customers a complete cab air quality system that includes fresh air and recirculated air systems combined with high-efficiency HEPA and EPA filtration as well as real-time CO_2 and pressure monitoring," says Postma.

"Tighter international standards – embodied in the ISO 23875 global standard for cab air quality – are leading the world's major mining companies to adopt better air quality control systems for their heavy machinery cabs and other operator enclosures," he explains. "The trend is also being felt in southern Africa, as mining and construction companies look for more effective dust control solutions."

The new ISO standard will require machine cabs to have a fresh air pressurisation solution, a recirculation system and a monitoring device, he points out. They will also need to be fitted with filtration that exceeds 94% efficiency at 0.3 µm, such as Sy-Klone's EPA and HEPA filters. Many mining and earthmoving vehicles and equipment are imported with filtration systems that are not suited for the region's dry and dusty conditions.

"Sy-Klone solutions can be retro-fitted onto vehicles and equipment to provide unsurpassed levels of protection and be in compliance with emerging standards," says Postma. "Higher levels of filtration also support the safety of machine users, promoting operator alertness and improving productivity."

He highlights that the Sy-Klone distributorship is a natural fit with Booyco Engineering's HVAC specialisation and experience – as more effective filtration for the cab also enhances the performance and lifespan of the air conditioning system.

"This collaboration allows us to offer an even more comprehensive solution to our customers' needs, harnessing the latest technology to meet rising global standards," he concludes.

www.booyco.co.za

Sy-Klone products can withstand extreme environments, reducing operator exposure to harmful particulates and extending engine life.

Integrated solutions deliver process improvements

"As mines look for opportunities to mine and process ore more cost effectively and sustainably, integrated solutions will play a growing role," says Teddy Malunga of Weir Minerals Africa. These can be applied in various on-mine phases from comminution to tailings, with significant commercial and environmental benefits.

Teddy Malunga, Regional Integrated Solutions Manager at Weir Minerals Africa.

Taking in the full scope of factors within any mining challenge or context, integrated solutions are the best way to reduce operational costs and increase throughput, while maximising water recovery and power savings.

According to Teddy Malunga, Regional Integrated Solutions Manager at Weir Minerals Africa, plant performance often drops over time – for various reasons. It may be that the combination of equipment is not optimal, or that the mined material being fed to the plant changes more than expected. The *ad hoc* replacement of individual items of equipment over the years could also lead to an imbalance in throughput capacity. All solutions, though, begin with close analysis leading to a thorough understanding of all the aspects of the circuit.

"When a client approaches us with a challenge in their circuit, we conduct a comprehensive audit in which we gather all the data we can on how the plant is currently running," he explains. "This includes comparing its overall performance to its original design parameters."

By analysing each stage of the process – and each item of equipment – conclusions can be drawn about where bottlenecks might occur. The solution that is designed should then be aimed at achieving the required key performance indicators such as throughput and target P80 – the particle size at which 80% of the product will be passed onto the next processing stage – while reducing downtime and raising productivity.

With the constant evolution of technology within the Weir Minerals range of solutions, the response to such an audit process usually provides the opportunity to optimise the process and address our customers' pain points, he notes.

An important element of integrated solutions is the ability to measure where potential equipment under-performance occurs, and to ensure optimal running conditions across the plant. Here, Malunga points to Weir Minerals' Synertrex® intelligent platform and its ecosystem of solutions. "Measuring wear rates, vibrations and temperatures on a pump in real time, for example, is a valuable indicator of where problems might occur," he says. "It also creates the opportunity to monitor performance and pick up variations from the expected performance parameters."

An integrated solution would then also be

In response to a client's challenges, Weir Minerals will conduct a comprehensive audit to gather process data before developing an integrated solution to improve productivity and reduce downtime.

able to demonstrate a tangible and measurable improvement to the customer, he adds. Among the potential benefits that would be identified could be improvements in plant throughput, capacity, availability, efficiency, or recovery – and often a combination of these.

An important aspect of system optimisation is to improve energy efficiency, as mines look to reduce their costs and their carbon footprints. Traditional mill circuit flowsheets – comprising semi autogenous grinding (SAG) mills and ball mills – are inefficient, with 40 to 60% of the slurry returned to the mill for reprocessing. This recirculated load reduces the throughput and capacity of mill.

"The redesigned and reconfigured mill circuit that Weir Minerals envisages will see the SAG mill replaced by a more efficient HPGR, which is less energy intensive, while also reducing recirculating loads threefold," he says. "Compared to traditional crushing and grinding methods, Enduron HPGRs can reduce energy consumption by up to 40%."

Similarly, the development of Weir Minerals' Cavex® 2 hydrocyclones allows a 27% improvement of capacity in the latest generation design, with a reduced bypass and better cut-point.

In terms of pump technology, Weir Minerals' products improve the numbers of hours pumps can run while reducing power consumption. The Warman® WRT® impeller and throatbush combination, is a simple inexpensive upgrade compatible with all Warman® AH®, M and L Series slurry pumps.

"The aim of Weir Minerals' integrated approach is to understand our customer's pain points and identify ways in which we can improve their process, which often leads to lower total cost of ownership," he says. "This leads to higher availability, throughput and profitability."

Underpinning its capability in providing integrated solutions is Weir Minerals Africa's unrivalled manufacturing and service network. It has service centres within 200 km of most major mining regions to ensure the company can deliver value quickly and effectively to customers.

"In the end, it is vital to take a holistic approach to solving customer challenges, and to be close enough to understand our customers' operations in detail," says Malunga.

www.minerals.weir

The Synertrex intelligent platform monitors performance in real time and indicates where problems might occur.

Enduron HPGRs can crush material to as small as 5.0 to 8.0 mm and they require significantly less water. Their use instead of a SAG mill can reduce recirculating loads threefold.

Weir Minerals' integrated approach is to understand its customers' equipment to improve their processes.

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The right pump for your dewatering application

Industry specialist for IPR, Steve du Toit, gives some practical guidance about choosing the right pump for a dewatering.

Choosing pumps for dewatering starts with asking the right questions.

Choosing suitable tools for a dewatering project starts with asking the right questions, according to Steve du Toit, product manager at dewatering pump specialist IPR, recently appointed master dealer in Southern Africa for Atlas Copco dewatering pumps. Du Toit argues that a good first question when planning a dewatering project should relate to the nature of the fluid to be pumped.

"You need to know the weight of the fluid, so the pump has enough power to draw the liquid through," he says. "In many cases, we find different fluid types on the same construction, quarrying or mining site: sludge, construction materials and other insoluble materials must often be pumped along with the fluid."

"It is also essential to understand the pH level in the fluid, as this indicates how acidic the liquid is," he explains. "The further the fluid deviates from the neutral – which is seven on the pH scale of zero to 14 – the more chemical impact the fluid will have on the pump's internal components."

Du Toit notes that the pump must be resistant to fluids with high acidic or base characteristics. Other important questions to ask are about the site itself. Is it readily accessible, for example, and is there electric power available?

"Most dewatering pumps are trailer-mounted or skid-mounted," he says. "A trailer-mounted pump system is easy to transport but may take up additional space on the jobsite. Also, if there is not a power source nearby, you will require a diesel-powered solution as an electric pump will not suit your needs."

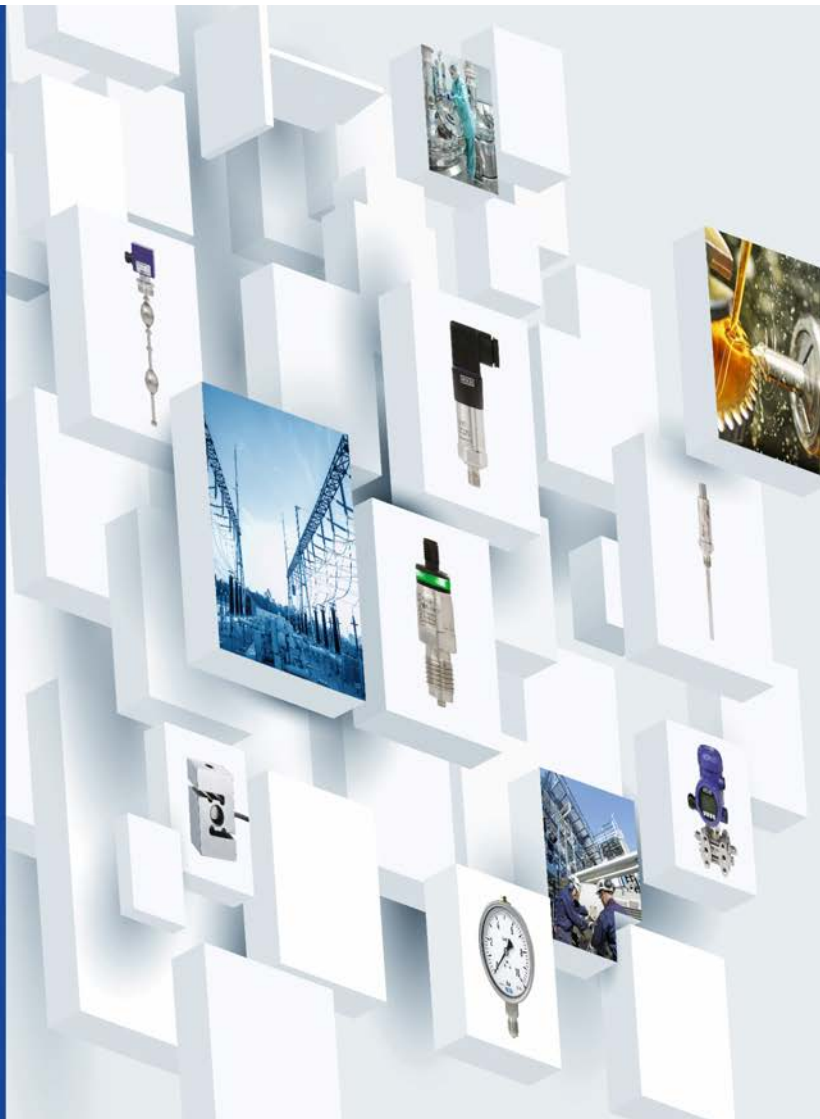
If there is elevation to deal with, fluid may have to be pumped uphill. The distance to be pumped will be a factor to consider. Also, the project may have certain system pressure and preferred flow requirements.

"Pumping uphill will require you to understand the static discharge head, which is the height of the source of the fluid you are pumping to the height of its destination," says du Toit. "Formulas will allow you to determine what pump you need based on the elevation, the lift needed, and the distance the fluid must travel."

Every pump has its own performance curve, which describes how much volume over time a pump moves under a given pressure rating. The volume that can be pumped over time is measured in litres per second or cubic metres per hour – and shows the pump's duty point or operating pump point.

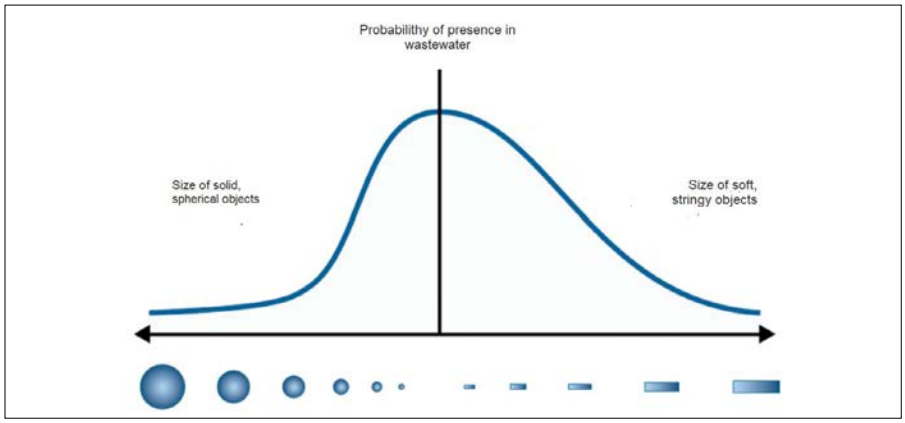
Du Toit highlights that professional help is close at hand with IPR, where experienced professionals can advise on all aspects of dewatering pump selection and on operating procedures and maintenance to get the most from the selected solution.

www.pumprental.co.za



The truth about wastewater pump clog resistance

The biggest issue with the throughlet rule is that it focuses on large and hard objects as the main culprits behind pump clogging and impeller damage. But a lot of research by Xylem shows that these are not the source of clogging problems.



A diagram showing the probability of finding different sizes and types of objects in modern wastewater, from large solids on the left to stringy materials on the right.

The number one requirement of a wastewater pump is its ability to pump wastewater without clogging, hence the importance of a pump's wet-end design for achieving clog-free operation. Xylem research has long established that a pump's throughlet size is a misleading parameter in specifying clog resistance. The traditional definition of throughlet size refers to the free passage of matter through a pump impeller. It is determined by the largest diameter of a hard, solid, spherical object that can pass through the pump. The concept is old, dating back to 1915, and was developed at a time when energy costs were not of significant importance. Wastewater pump manufacturers intuitively believed that pump clogging could be avoided simply by ensuring that a wastewater pump's throughlet size was equal to or larger than a toilet outlet pipe.

Decades of research and development, along with experience from hundreds of thousands of pump installations, however, have proven that this simplistic logic is incorrect and misleading, yet it remains prevalent in wastewater pump procurement specifications.

Pump manufacturers achieve large throughlet sizes by opening the pathway through the impeller. There are two main impeller-design options to maximize this throughlet size: single-vane impellers, open or closed; and vortex impellers, which are known as recessed impeller or torque-flow impellers. Both designs suffer from drawbacks. Single-vane impellers, unless they are being used to pump clean water, have a relatively low efficiency since pumps with more impeller vanes can deliver significantly higher efficiencies. Also, significant rotating radial forces cause high shaft and bearing loads, as well as increased vibration and noise. They are also difficult to balance – the impeller is water-filled during operation – and impeller trimming often leads to further imbalance. Vortex impellers, on the other hand, have low hydraulic efficiency due to the large open area between impeller and volute.

Investigations and studies of modern wastewater have shown that it rarely contains hard, solid, spherical objects. Objects that are truly solid and hard – such as stone, brick or steel – are rare, and these items seldom reach the pump because they will be trapped on a flat horizontal surface where the liquid is stagnant, or the flow velocity is low.

By far the most common solids found in municipal wastewater are organic and often consist of long and stringy materials such as fibres. Modern wastewaters also contain a higher amount of synthetic cloth and artificial fibres. The vast new array of household cleaning products, such as tissues, wipes, and dishcloths are to blame. Many consumers flush them down the toilet, thus adding synthetic fibres to the wastewater stream.

The diagram alongside shows the probability of finding different types of solids in wastewater. The left side shows hard spherical objects (stone, gravel, sand, grit, silt, etc.) and the right side shows objects of various sizes and shapes, from circular to large and elongated. The distribution curve shows that there is a very low probability of finding large, hard objects compared to small, hard particles and various small and large soft and stringy organic objects.

How traditional hydraulic designs are affected

Stringy objects tend to get caught in traditional impeller types even if the throughlet size is large. The problem point is the lead-

Xylem Flygt pumps with Adaptive N™ technology can prevent clogging while delivering better energy efficiency and reducing unplanned maintenance.

ing edge of the impeller vanes. All impeller designs have one or more vertical leading edges. Soft, strong and elongated objects in wastewater are continuously fed into the pump and some of these will meet a leading edge on one of the impeller vanes. The fibres tend to wrap around the edge and fold over on both sides of the vane. On straight and moderately curved leading edges, the debris will not dislodge, leading to accumulation.

This creates big lumps or bundles of solid organic material sometimes called rag balls. As these accumulate in a traditional impeller, the following become likely:

- The flow rate of the pump decreases as the solid objects start to constrict the free passage of liquid, usually leading to decreased efficiency. This phenomenon is called soft or partial clogging because although the pump continues to operate, it takes longer to pump down the sump with a constricted impeller.
- The input power increases when accumulated objects make contact with the volute. This is due to drag, which leads to lower efficiency and the risk of a trip due to motor overloading. The solids act as a brake, which increases the required input power. Once the running current exceeds the trip current, the pump shuts off due to hard clogging.

With decreased pump efficiency, the operational cost for the end user is increased because the pump has to operate for a longer time to handle the inflow. A motor overload or pump trip also adds cost for the end user because it requires a service technician to visit the pumping station in order to clean and restart the pump.

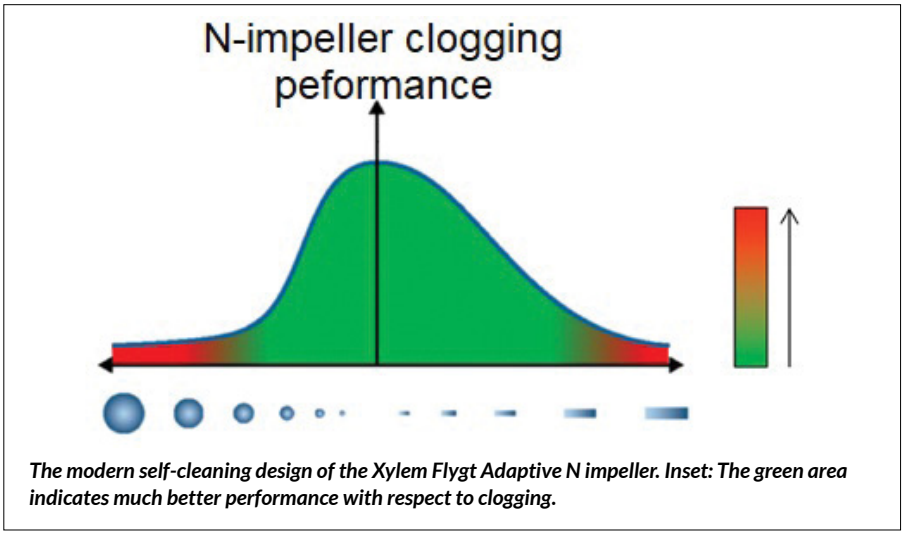
For pumps operating intermittently, back flushing will occur naturally every time the pump is turned off. This can clean the leading edges of the impeller and flush the accumulated solids back through the pump's suction and into the sump. This flushing phenomenon also occurs in systems with check valves, which all wastewater pumping stations must have.

Some hydraulic designers claim that their impellers are self-cleaning because back flushing frees the impeller of solids. In practice, however, this is not the case. Even if the back flushing frees the impeller from the stringy objects, they return during normal operation, again leading to a significant decrease in efficiency and higher energy bills.

Modern pump hydraulic design

Today there are better and more advanced hydraulic designs available to increase a wastewater pump's clog resistance and to maintain pump efficiency over time.

Xylem's N-technology self-cleaning design, with substantially horizontal backswept leading edges and a relief groove, has proven to be the answer to most clogging problems.



The modern self-cleaning design of the Xylem Flygt Adaptive N impeller. Inset: The green area indicates much better performance with respect to clogging.

This was followed by Adaptive N-hydraulics, a Xylem innovation that further improves the N-technology's self-cleaning characteristics for small pumps. Wastewater pumps with Adaptive N-technology offer unmatched clog-free performance and high sustained efficiency. This is achieved through a patented axial movement of the Adaptive N-impeller on the pump shaft.

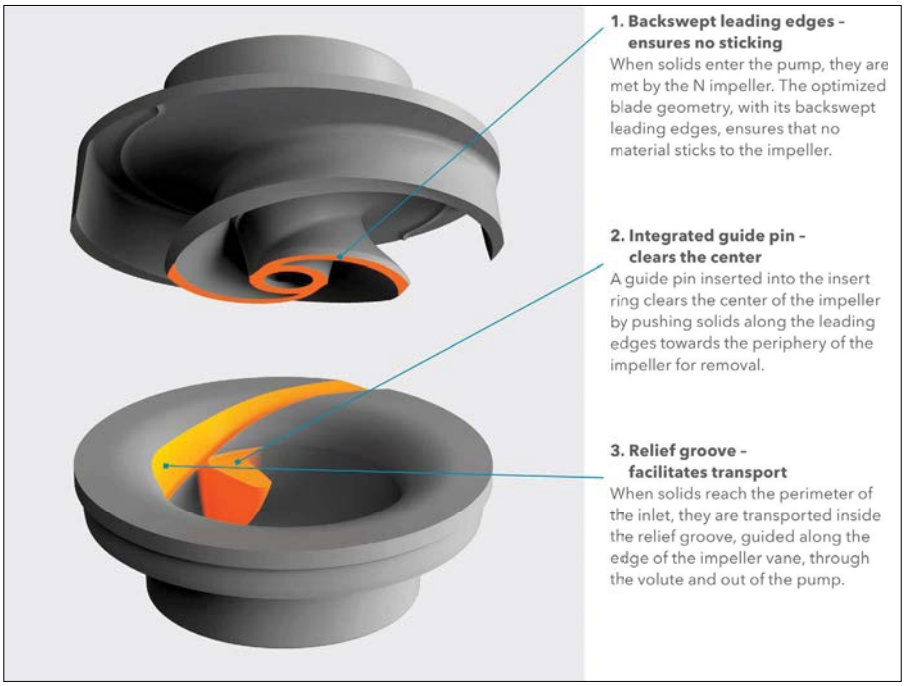
The Adaptive N-impeller moves axially away from the insert ring when an extra heavy load of solids is detected, allowing the bulkiest rags and toughest debris to pass through. After the debris is pumped out, the impeller automatically returns to its normal operating position, restoring clog free efficiency.

The axial movement of the impeller also reduces stress on the shaft, seals and bearings, thereby extending pump life. The reliable, clog-free performance that a Xylem Flygt Adaptive N-technology pump delivers results in peace of mind and minimal maintenance. All in all, Adaptive N-hydraulics assures reliable and economical wastewater pumping.

Modern impeller design now separates the transportation of liquids from the function of transporting solids. A self-cleaning approach prevents the accumulation of typical stringy and fibrous contaminants present in modern wastewater. Solids that land on the leading edges of the impeller are continuously pushed out through the pump discharge.

To avoid clogs, do not focus on the throughlet size. Large objects are not the problem; buildup of fibres are the leading causes of clogs. The right impeller design makes all the difference, keeping wastewater pumps running at their best for longer.

www.xylem.com/en-za



Cyclone technologies for efficient size, mass and density-based separation

Ernst Bekker, Product Specialist – Cyclones, for the Multotec Group, talks to *MechChem Africa* about hydrocyclones and dense medium cyclones: how they work, their different applications and some of the things to look at, and to avoid, for best possible separation, production, and recovery efficiencies.

"Cyclones are divided into two main categories: hydrocyclones and dense medium cyclones, which are fundamentally different in terms of the principles that apply, and the mineral separation processes they can be used for," begins Multotec's Ernst Bekker.

Hydrocyclones use water as the transport medium. The solids that require separation are mixed with water to form a slurry, before being pumped into the cyclone near the top and at a tangent to initiate spiralling flow. A strong vortex forms at the centre of the cyclone, with an air core through its centre passing from the spigot at the bottom to the vortex finder at the top.

"Centrifugal forces from the spiralling flow tend to throw particles to the outside, while drag forces from the water being pulled towards the air core at the vortex pull particles in the opposite direction. So a balance of the forces emerges," says Bekker. "The coarser particles tend to be thrown to the stream spiralling downwards on the outside, while the finer particles tend to migrate into water surrounding the air core, which is being forced upwards by the vortex. The water closest to the air core takes the finer particles up and out of the overflow at the top, while the coarse particles continue to flow down the outside of the spiral, passing through the spigot at the bottom as underflow," he explains.

It is this balance of the forces that dictates the cut size of a hydrocyclone. "It is important to remember that a hydrocyclone predominantly separates the mineral particles in the slurry based on size, with larger coarse particles reporting to the underflow while smaller or finer particles are taken up and through the overflow," Bekker informs *MechChem Africa*.

Ideally, he says, Multotec recommends a ratio of solids to water of about 20% solids by volume in 80% water. "Sometimes people try to push more solids into the cyclone to raise the throughput of the plant, or tonnes/m^2 of processing footprint. But this will tend to inhibit the performance of the hydrocyclone, so we never like to exceed 30% solids by volume," he advises, adding that higher solid volumes tend to result in lower separation efficiency and poorer recoveries and/or increased product circulation.

"When multi-density particles enter the mix, then a hydrocyclone, in essence, separates based on mass. With homogeneous ores, mass and size are directly related, because bigger particles always have bigger mass, so we can still use the term cut-size to describe the separation process.

But when the densities are different, this is not the case. In a multi-density classification application, a larger fraction of the high-density material will report to the underflow compared to a mineral that has a lower particle density. This is a challenge for hydrocyclones in a multi-density environ-

Multotec hydrocyclones are used across the world for applications in mineral processing and other industries. The industry-proven product range has been optimised over hundreds of applications to improve classification efficiency, provide greater lifespan and reduce energy requirements.

ment," he says. Bekker cites an example in the PGM industry. "The UG2 ore body consists of silicates, which are platinum bearing and are generally lower density mineral ores. But chrome, which has a significantly higher density, is also present.

"If the hydrocyclone is being used in a closed-loop milling application, the chrome should leave the cyclone at the same particle size as the silicates, but due to its higher density, the chrome keeps reporting to the underflow as oversized material and is sent back to the mill for further grinding. This leads to overgrinding of the chrome ore, which comes out so fine that it contaminates the platinum concentration process downstream," he explains.

"In this case, the use of an ultra-fine screen might be introduced, but this is expensive, so many operations decide to continue to use hydrocyclones, while understanding their limitations," Bekker says.

Multotec's cast iron dense medium cyclone range provides guaranteed separation efficiencies and maximum wear life. This range of cyclones is cast in 27% high chrome, which provides excellent wear resistance and out-performs all other castings.

Hydrocyclone applications

"Hydrocyclones are quite versatile. In some cases, we can even use them for dewatering instead of using dewatering screens, which can be expensive, and they have a larger footprint," he says. Similarly, desliming is also common, where 98% of the solids are taken out at the spigot, with relatively clean water being taken from the overflow.

"In applications where the quality of the clean water produced is less important, hydrocyclones can be used for mine water processing in place of thickeners. And there is also now a focus on hydrocyclones being used for tailings dam management, depositing sand on the dam walls while recovering as much water as possible for reuse back in the process," says Bekker.

On chrome mines, hydrocyclones, called stacker cyclones, sit on booms, discharging the product underflow into a heap. After leaving the material to dry for a couple of days, this product will be taken away by trucks for further processing.

In the minerals sands industry, where beaches are often mined for heavy minerals such as zircon and rutile, hydrocyclones are used to separate ultra-fine material before spirals and to dewater the product. The sand no longer containing any valuable material is returned onto the beach. Compared to using a screen for separation, a hydrocyclone is far easier to move along the beach as mining progresses, the sand being redeposited behind the operation.

A most common application is for hydrocyclone clusters to be used as part of the mill circuit to classify right-sized material and to send the oversized fraction back to the mill for further grinding. Here, the cut size needs to be optimised to best match the downstream recovery process. "It is important for operators to remember that there is a limited amount of grinding energy from a mill, so raising throughput should be undertaken with care. Unless mill capacity can be increased in some way, any increase in throughput will result in more oversized material returning to the mill, which can cause the spigot to choke-up, a condition known as roping in the cyclone fraternity," he warns.

"To get a finer product for processing at a higher production rate, the milling energy must also be raised and the cyclone re-optimised to match the new operating point," suggests Ernst Bekker.

Dense medium separation (DMS)

Instead of using pure water as the slurry medium, dense medium separation uses a combination of water mixed with very fine particles of either magnetite or ferro-silicon. This creates a higher density separation medium than water, so when the ore is added, the slurry is better able to separate based on the different densities of the particles in the mix.

"If you took a truck load of ore and dumped it into a pool of water, everything would sink to the bottom. But if you replaced the water with a magnetite- or ferro-silicon-based dense medium with an elevated density relative to water of, say, 1.6 then lower density ores will float and any of the particles that do sink will have a density of above 1.6," he says.

"With a dense medium cyclone, low density materials, called floats, can't break into the medium and so they remain in the centre of the cyclone, are drawn to the cyclone's vortex and leave through the overflow. Dense minerals sink inside the spiralling dense medium flow and are propelled towards the outside of the cyclone. They leave through the underflow. So, separation is largely based on low density and high-density minerals, irrespective of particles size.

"To control the cut density on a DMC (Dense Medium Cyclone), we have to adjust the density of the media being used, based on the densities of the ores being separated. The density of the medium governs separation and there is very little we can change in the cyclone itself to improve separation performance," Bekker points out.

Reverting back to hydrocyclones, he says the diameter of the vortex finder is the principal cut-point adjustment, with a smaller vortex finder diameter providing a finer cut point and vice versa. Feed conditions such as pressure or flowrate and feed solids concentration can also be used to manipulate the cut size of items reporting to the overflow and underflow of a hydrocyclone. "This is not the case for dense medium cyclones, however. The operating pressure or head remain constant in dense medium separation, and the separation efficiency of the unit cannot be changed by adjusting the size of the vortex finder or the spigot," he adds.

The supplier designs the DMC based on the ore body densities and the separation requirements, selecting a dense medium that delivers the low-density material to the overflow and the high densities to the underflow. "Unless there are significant changes to tonnages or the densiometric profile of the ore body, there should not be any need to change the DMC units themselves. Any adjustments should be made externally, to the dense medium and the feed parameters, for example," Bekker explains.

Dense medium cyclones and coal quality changes

"South Africa's coal quality used to be very good. When using a dense medium cyclone

in the early years, this resulted in easy separation, typically with 70% being coal at the overflow and only 30% being rejected as waste rock to the underflow. But we are now dealing with much lower grade coal ore, so the ratio is more or less the other way around, 70% being rejected as waste material through the spigot and only 30% being separated out as coal at the vortex finder in some cases," Bekker notes.

"This causes capacity issues at the spigot in handling the larger volumes of waste materials and a decision has to be made as to whether to make the spigot bigger or to replace the dense medium cyclone with a bigger one," he adds.

He says that certain design ratios apply between the cyclone diameter, the vortex finder, the spigot and the inlet diameter. If the cyclone diameter is D, for example, then the vortex finder is normally 0.43×D and the spigot can be anything between 50% and 70% of the vortex finder diameter. The standard inlet opening of a dense medium cyclone is normally 20% of the cyclone diameter.

"If the inlet opening is made bigger, more volume can be introduced into the unit, but this reduces the residence time inside the cyclone, which results in more misplacement of waste in the overflow and/or coal in the underflow, particularly in the case where the near density material (NDM) is high. Near density material is defined as the amount of material present around the expected cut density in a band of +/- 0.1 RD units. For example, if the cut density is RD1.6, then the material present in the density range of RD1.5 to RD1.7 would be classified as near density material.

If the percentage of NDMs is very high, let's say above 65%, then separation is difficult. Easy separation has anything between 20 to 25% NDMs and for medium density cyclones treating very good quality coal, NDM percentages can be as little as 2% in some of Multotec's overseas operations.

"But here in South Africa, we use a lot of low-grade coal and it is quite difficult to distinguish clearly between the good coal and the waste. There are operations that can have up to 90% of the ore coming into the dense medium cyclone that is classified as near density material, making separation very difficult," Bekker tells MechChem Africa, adding that cyclones for these applications need to be sized correctly, with very accurate feed conditions.

Diamonds and pre-concentration prior to milling

Alongside coal, Bekker says that dense medium cyclones are widely used as part of diamond pre-processing from run-of-mine ore prior to sorting. "Here only 1 to 2% of the inflow is diamond bearing and this passes through the spigot. The rest all goes out through the overflow.

And if the underflow ratio goes up to just 4 or 5%, it becomes a problem because of the very accurate diamond sorting processes that must take place downstream of the cyclone, which can easily become overloaded," says Bekker.

In a similar way, he adds that dense medium cyclones are now being looked at to pre-concentrate iron ore; manganese; and for some PGM and copper applications. "The idea is to remove waste rock before sending the product to the grinding mill, so all the milling energy is focused only on the valuable target material, which is an interesting cost saving and productivity increasing concept," he adds.

"While a small percentage of the valuable material is likely to be lost to the DMC, if you can recover 90 to 95% of the valuables from 30% of the total ore mass, then the savings and productivity improvements from reduced milling can far outweigh this loss," he points out.

"At Multotec, we are process specialists who offer a variety of different minerals processing solutions and combinations. We spend time with the clients, building trust and sharing knowledge, regardless of any associated order or monetary value. And because we are an OEM supplier of several different technologies, we are able to steer our clients towards the right combination of technologies, whether those involve hydrocyclones, dense medium cyclones or combinations of several technologies.

"Every system we design and build is customised for specific client needs to be fit-for-purpose – and we take responsibility for ensuring this is the case," Ernst Bekker concludes. ❑

Multotec's range of ceramic lined cyclones provides the ultimate in wear resistance with its alumina tiled cyclone engineering design.

A common application for hydrocyclone clusters is in a mill circuit to classify right-sized material and to send the oversized fraction back to the mill for further grinding.

FLSmidth delivers beneficiation equipment to phosphate mine

Following a long-standing relationship with Ma'aden, FLSmidth has been chosen to supply the key technologies and services for Ma'aden's phosphate 3 phase 1 mine site in the Northern Province of Saudi Arabia.

FLSmidth is a full flowsheet technology and service supplier to the global mining and cement industries.

FLSmidth has partnered with Ma'aden from the onset of the new phosphate mine operations in Saudi Arabia, starting with initial laboratory testing of samples retrieved from the ore body in 2019 through to the development of the flowsheet and pilot scale testing. The focus of the collaboration all along has been to ensure that the integrity of the flowsheet is maintained, while ensuring that the technology is well integrated into the overall plant design to deliver best possible performance from plant operations.

With this new order, FLSmidth will supply all the key equipment associated with the phosphate beneficiation plant as well as technical support services through the design, construction, commissioning and ramp-up phases.

The order includes primary and secondary sizers, apron and HAB feeders, cone crushers, screens, cyclone clusters, ball mills, paste and high-rate thickeners, horizontal belt filter, slurry pumps knife-gate valves and flotation columns.

"We are pleased to collaborate with Ma'aden on the expansion, as this order sets another strong standard for our MissionZero agenda.

In particular, the incorporation of our paste thickening and dewatering technology at this important mine site plays a key role in reducing emissions and water use from the beneficiation process," says Mikko Keto, CEO of FLSmidth.

www.flsmidth.com

Radiometric mass flow **measurement in lime works**

When rock leaves a crusher with different particle-size fractions, there is no place for sensitive, easily damageable processing equipment or sensors. That's why the operator of a major lime works decided to use a radiometric system from VEGA for precise mass flow measurement.

The complete system consists of a WEIGHTRAC sensor, a frame, and a protective container with the radiation source. It operates contactlessly and is thus wear and maintenance free.

The Lhoist Group is a world leading company that specialises in burnt and unburnt lime products. Headquartered in Belgium, the company is present in 25 countries with more than 100 subsidiaries around the globe. Rheinkalk is a Lhoist Group company in Germany that operates the Flandersbach plant in Wülfrath, the largest plant of the Lhoist Group and the largest lime works in Europe. Around 7.5 million tonnes of limestone are mined there every year. The production of unburnt limestone products in Wülfrath amounts to approximately 4.0-million tonnes. The raw limestone is either used as grit for road construction or it is ground and further processed.

A special hallmark of the Flandersbach plant is the very high quality of its burnt lime. Some of this material is further processed there, but approximately 2.0-million tonnes of it leaves the plant every year as an end product. Lime is known mainly for its use as a flux in steelmaking processes. However, lime and limestone products are also an indispensable raw material in drinking water and sewage treatment, in construction and agriculture, and in flue gas cleaning.

Since it is a non-contact measuring instrument, wear is not a problem when using the WEIGHTRAC 31 system from VEGA.

The quality demands placed on these products have grown steadily over the years. For example, the grain size specified by the customer must be strictly adhered to. At the same time, delivery periods are getting shorter and shorter. These factors, as well as many others, make it necessary to measure the material quantities much more accurately than ever before.

Precision feeding

Lime processing begins with the extraction of limestone from the quarry. The material is transported on large haul trucks to a processing plant where it is pre-crushed, washed, pre-sorted according to size, and distributed to various storage areas. From there, the prepared material is further refined or fed into burners. With the help of rotary and shaft kilns, the raw minerals are converted into lime products. At the end of the production process, the fired products are ready for a wide variety of applications.

Numerous conveyor belts with different lengths ranging from a few metres to one kilometre ensure that the limestone, which can be in a wide variety of different processing states, is transported to the right place for further processing. Ambient conditions are harsh. Operating at speeds of up to 4.0 m/s, the belts transport rock with diameters from 1.0 to 250 mm at delivery rates up to 4 000 t/h. Moisture, dust and dirt are the order of the day here. Nevertheless, exact measurement of this mass flow is required to ensure that downstream processes are fed with the right amount of material.

To measure the quantities passing through, mechanical belt scales are installed at strategic points in the conveyor belt systems. These

The PROTRAC series from VEGA offers a variety of sensors that can be optimally adapted to any radiometric measuring task. They are used on conveyor belts or screw conveyors, bunkers, silos and pipelines.

The inclusion of a WEIGHTTRAC mounting frame makes it easy to retrofit the measuring system onto any conveyor system. In this application, the source is mounted above, and the detector mounted below.

scales are, however, susceptible to dirt and grit and require a lot of maintenance. They must be checked and cleaned every few weeks, at considerable cost. In addition, belt scales take up a lot of space, requiring pre-run as well as post-run sections, and they must be set up perfectly level. Many conveyor belt scales, therefore, do not function optimally despite intensive maintenance.

The VEGAS WEIGHTRAC 31

In May 2014, VEGA recommended a trial measurement using WEIGHTRAC 31, a sensor based on the radiometric measuring principle.

This sensor has proven to be particularly useful in applications that are heavily soiled, wet, or dusty. What is more, it is mechanically robust and requires little maintenance. With radiometric measurement, level, density, mass flow, limit value and point level can be measured at a wide variety of locations: on conveyor belts or screw conveyors, or in bunkers, silos, basins or pipelines, for example. Although primarily designed for mass flow measurement, WEIGHTRAC 31 also works well as a position or limit switch and as an overflow detector. Overall, mass flow and density measurement are its two main applications in this industry.

The system consists of a scintillation detector and a radioactive source safely enclosed in a source holder. A minimally radioactive isotope emits focused gamma rays that penetrate the bulk material.

The receiver, which is mounted below the belt, picks up this radiation. Because gamma rays are attenuated when penetrating matter, the receiver can calculate the rate of mass flow from the intensity of the incoming radiation and the speed of the conveyor belt. The speed can either be stored as a fixed value in the system or measured by an impeller.

Thanks to its well-designed mounting frame, WEIGHTRAC 31 can easily be installed retroactively on conveyor belts. Since it is a non-contact measuring device, wear is not a problem. Radiometric measurement, which requires extremely little space compared to traditional mechanical belt scales, makes reliable measurement possible even in applications with fluctuating belt tension and strong vibration. It thus ensures exact balancing of the bulk solid material.

The acquisition costs of a WEIGHTRAC measuring system are comparable to those of a belt scale. However, the maintenance costs of radiometric measurement are minimal after installation and commissioning. To be on the safe side, Rheinkalk first put the new measuring principle to test for several weeks on a running conveyor belt. The results were convincing, so the company decided to leave it in place.

But that's not the end of the story: three more radiometric systems from VEGA have been installed in the meantime and a fifth and sixth are to follow. ❑

Radiation-based mass flow measurement

A radiometric sensor consists of a sealed radioactive source in a source holder and a scintillation detector. The source and detector are mounted on opposite sides of the conveyor (belt, screw, drag chain, or vibrating). In some applications, the source is mounted above, and the detector is mounted below, while in other applications the detector is mounted above and the source below.

In either case, a fan-shaped collimated beam of radiation is transmitted from the source through the process material and the conveyor to the detector.

As radiation passes through matter, its field strength weakens. As the loading of the material, or total mass per square foot, on the belt or screw conveyor changes, the amount of radiation reaching the detector changes. The greater the loading or mass on the belt, the lower the radiation field at the detector. Conversely, the lower the loading or mass on the belt, the higher the radiation field at the detector.

The amount of radiation seen at the detector is thus proportional to the amount of material on the conveyor and is translated into an output signal from the detector. ❑

BBE: SA's Olympian mine ventilation and cooling specialist

MechChem Africa talks to Richard Gundersen of BBE Group, a world leading and independent engineering consultancy for mine ventilation and cooling solutions. With over 30 years of design and development experience, BBE Group has been involved in many of the deepest and most challenging mine ventilation, cooling and heating projects in the world.

The two men who started BBE in 1989, Stephen Bluhm and Rod Burton, came from the Chamber of Mines Research Organisation (COMRO). They were key researchers on the ventilation and cooling aspects of hot mines. But towards the end of the 1980s, "They detected the need for a client consultancy to help mining companies resolve the challenging issues of deep mine ventilation, which they were unable to offer from within COMRO. So in 1989, they formed Bluhm Burton Engineering (BBE) as an independent engineering consultancy specifically for mine ventilation and cooling," BBE Group director, Richard Gundersen, tells *MechChem Africa*.

Coleman plant nearing completion. All major structures and equipment is installed and the contractor is adding finishing touches before commissioning.

Vale's Coleman mine's 10.5 MW cooling plant in Sudbury, Ontario under construction, showing the cast concrete, the chillers delivered and the condenser cooling towers under construction.

"Then, in the late 1990s, the mining industry embarked on a genuinely industry-wide research project called DeepMine, which was set up to explore the feasibility of mining at depths of between 4 000 and 5 000 m," says, Gundersen.

"This was a huge project, involving CSIR-MiningTech (previously COMRO), mining houses, universities and consultancies. Initially I was involved through Gold Fields, where I was a consulting engineer, and I joined BBE during the course of this investigation. Basically, DeepMine was about identifying the showstoppers for mining at these depths: the costs, the power involved, safety and, of course, in our case, the technologies for ventilation and cooling.

"Mining down to 5 000 metres was found to be viable, but nobody needed to go there yet. We ended up with tables of metal-price thresholds that would be needed for financial viability, along with a lot of insight into the technologies and solutions we would need to develop and apply," he continues.

South Africa, through COMRO, the DeepMine Project and other initiatives, continued its dominance in mining research into ventilation and cooling in deep level, narrow-reef mining and deep block cave mining in the diamond and copper industries.

"South Africa has deep and hot mines with challenging ventilation and cooling issues. BBE has since kept developing this core expertise and is now over 30 years old. Our founding members have some 100 years of direct collective experience in cooling and ventilating mines – in South Africa, across Africa and in every continent of the world apart from Antarctica," he adds.

Gundersen's work in the ventilation and cooling field for Gold Fields put him in close contact with BBE and he joined them in 1999. "When the platinum and coal mines were unbundled from Gold Fields, my colleagues invited BBE to bring my project engineering and a colleague's civil engineering experience to the company to help them build an extension to the refrigeration plant at Northam Platinum. So we put a project team together and established BBE Projects, with Northam Platinum's cooling plant being our first success.

"We designed and built some early systems on an EPCM basis for Impala Platinum. Then Anglo American wanted two plants for Obuasi Mine in Ghana on a full turnkey basis. Incredibly, we established the first refrigeration plant in Ghana in just seven and a half months. This still blows my mind compared to how long it now takes to negotiate all the legal and bureaucratic permissions required to establish any new plant these days," he says.

BBE Projects quickly developed a very good and lasting reputation across the African continent. "We obviously have a very strong consultancy operation, with 85% of our staff working as engineering consultants on the cooling and ventilation side. There are only a dozen of us doing project work, but design team consultants will often slide over to the project team when we start to implement a project. We now also have two Australian offices – in Perth and Brisbane – and a Canadian office, which brings our total staff complement to over 100 people.

"Because of Covid, we have learned to have conversations with people all over the world and, in many ways, we have become more productive. We can now attend meetings that we weren't able to travel to, for example. Our default is to work from our offices, though, because we feel that engineers need to be able to walk into the drawing office, talk to the electrical or civil engineer, for example, and make ad-hoc decisions. Spontaneous conversations don't quite happen in Teams," he suggests.

He relates that during Covid, Andrew Branch, the current MD for BBE Projects, completed a project in Canada at Vale's Coleman mine in Canada. "The project started at the end of 2019, but Covid hit a few months later in March 2020, so he had to run the whole project – in a new country with a new client and a new construction team on the ground – remotely from South Africa." This despite several commissioning challenges, including limited space availability for the 10.3 MW air cooling plant, a very short delivery time, and power availability shortages.

"The Coleman mine has one plant where gas burners must be used near the surface in winter to prevent water pipes from freezing. These are the types of projects we like to get involved with, because we understand how the climatic influences on the mine affect the cooling system design and demand.

"A mine in Ghana, for example, might to need a cooling system that runs for 12 months a year, at part load for a couple of months. In Canada, though, they run the heaters for three months, they may go through spring and autumn with nothing running, and then will need cooling for the three months of summer. So the design criteria change, because the low usage factor makes it unviable to use a sophisticated chilled-water system like the ones we use in the deep gold and platinum mines in South Africa," he explains.

He cites another interesting Canadian project, not one of theirs, where mining takes place under permafrost. "The ground on the surface is a friable shale-type rock, bound together by ice. If the ice melts, there is a risk of shaft collapse, so to keep it frozen, a pipe network has been installed down to about 20 to 30 m, with a refrigerant at around -10 °C continuously being pumped through it," Gundersen informs *MechChem Africa*.

"We understand that every client system has different nuances: the cost of electricity, remoteness or it might be totally off-grid: the list is endless. We don't do plugin solutions, and while we have a lot of experience to start from, we always need to include modifications to meet site or climate conditions," Gundersen notes.

The key reason for BBE Group's success? "We stick to our knitting," Gundersen responds. "We have become specialists in every aspect of mine cooling and very few competitors have our breadth of knowledge. We see the bigger picture: a mine's next extension plans, where the new shafts and declines might be and the mining fleets generating the heat loads.

Gundersen also lifts out the BBE-developed VUMA mine ventilation simulation software as a reason to be proud. "We see VUMA as a program with AI capabilities, which I prefer to call 'applied intelligence', because the intelligence is not artificial. VUMA was created using our experience of real ventilation systems.

The software incorporates our engineering intelligence with respect to heat flow for mine cooling requirements and how that can be best managed," he explains.

"Over the top of that, we have created better and better user friendliness. So it becomes possible to build a mine model very quickly, which can then be developed into a cooling and ventilation model.

Our VUMA program guides users into the specifications for their mine cooling requirements so the simulation results are always within a realistic range. It really is a pleasure to use and a great tool for initiating sophisticated mine cooling systems," he adds.

The future outlook? "We've never had to cut back and we continue to grow steadily," says Gundersen. The mining industry will always need cooling and we will be on standby to deliver. The fact that we continue to get more work suggests that the mining industry is robust and expanding.

Surface mines are going underground, underground mines are going deeper and the world cannot get enough of the minerals it needs, such as copper and lithium.

"When it comes to pure ventilation, we encounter stiff competition, but if cooling is involved, few can deliver what BBE can," he concludes.

https://bbe.co.za

Left: ***The main upcast fan station on the Eastern Limb of the Marula Platinum mine in Limpopo Province of South Africa.*** *Right:* ***The refrigeration plant at Newmont's Subika mine in Ghana just after construction and commissioning has been completed.***

Zest WEG powers Kipushi's new dawn

Mining in the Democratic Republic of Congo (DRC) is seeing the rebirth of the historic Kipushi Zinc-Copper Mine in the Katanga province, and Zest WEG is providing key electrical and energy infrastructure.

Zest WEG is providing key electrical and energy infrastructure to the historic Kipushi Zinc-Copper Mine in the DRC's Katanga province.

As part of Ivanhoe Mines' refurbishment of the historic Kipushi Zinc-Copper Mine in the DRC, Zest WEG will be supplying a range of electrical and energy solutions. Ivanhoe Mines acquired its 68% interest in the Kipushi Project in November 2011, with the balance of 32% being held by the DRC's state-owned mining company, Gécamines.

According to Luveshen Naidoo, business development and external sales engineer for Mining and Industrial at Zest WEG, this includes a 14 MW power plant, motor control centres (MCCs), WEG medium voltage (MV) variable speed drives (VSDs) and a WEG 1 200 kW MV motor for the mine's ball mill.

The company is also the preferred supplier of low voltage (LV) motors and will supply these to a range of mechanical Original Equipment Manufacturers (OEMs) servicing the mine. Delivery of the equipment is expected to begin in the third quarter of 2023.

"Our diesel-powered plant, which will provide the mine with backup energy, has been designed to comprise 12 generator sets – each rated at 1 587 kVA and 400 V," says Naidoo. "Assembled at Zest WEG's specialised Cape Town facility, the plant includes MV switchgear, six 3 150 kVA ONAN type 400 V/6.6 kV step-up transformers, a 40 000-litre fuel tank and an automated fuel system."

He highlights that splitting the plant design into smaller generating units ensured engines and alternators were readily available, securing a quicker delivery time. The configuration of the plant in this way gives the mine greater energy security in the case of maintenance or breakdown. The gensets can also be transported to site using conventional trucking, without the need for abnormal load vehicles.

The MCCs are being supplied for use in an established substation on the Kipushi Zinc-Copper mine, as well as for a containerised substation elsewhere on the site.

To accommodate space constraints, the MCCs are designed for a back-to-back configuration with a compact bucket size, he explains. "This ensures that the equipment will fit in the available space while still meeting the client's specification and stringent IEC standards," he adds.

For the mine's SAG mill, Zest WEG is providing the WEG W60 MV motor rated at 1 200 kW – a robust unit for the demanding applications and aggressive environments found in the mining sector, says Naidoo. The reduced motor weight holds distinct benefits, he notes, including a compact base plate or plinth onto which it is mounted – and lower installation costs.

The motor's IP55 rating ensures the motor is well protected from dust and water ingress.

www.zestweg.com

Zest WEG is supplying a range of electrical and energy solutions to Kipushi Zinc-Copper Mine in the DRC.

Gearless mill-drive winding project for Panama copper mine

Marthinusen & Coutts (M&C) has completed an on-site winding and sub-assembly of an 18 MW gearless mill drive for a new ball mill at the Cobre Panama copper mine as part of the expansion of its processing plant.

M&C's seven-man on-site team, led by Divisional CEO Richard Botton, performed an on-site winding and sub-assembly of an 18 MW gearless mill drive in 40 days during October and November last year, this for a new ball mill at the Cobre Panama copper mine in Panama.

"We already knew from previous experience that the working conditions at the mine are extremely tough, due to frequent heavy rain, high humidity and excessive heat. But our familiarity with the procedures involved helped to ensure that the project went according to plan and was completed on time," says Richard Botton, adding that due to their complexity the winding and sub-assembly had to be done on site.

"Our preparation is extensive and starts about six months prior to site establishment. The machine is transported to site from the OEM in Europe in four quadrants, each of which weighs 85 tonnes. We are responsible for the connecting and continuity between the four segments, which had been pre-wound by the OEM," he explained.

"About half of the tools we use for the on-site work are purchased and supplied by the mine itself, while we have to supply and bring with us the remaining more specialised tools, along with the test equipment that is needed." As previously, M&C was contracted for the latest project by the Cobre Panama mine's owners and operators, Minera Panama, the Panamanian subsidiary of the international mining company, First Quantum Minerals (FQM).

M&C has also executed four on-site winding and sub-assembly projects on gearless mill drives for FQM's Sentinel copper mine in Zambia in recent years. ❑

The members of Richard Botton's on-site team at Cobre Panama mine** (from left)**: Wynand Willemse, Arno Snoer, Shadrack Mazibuko, Eugene Nekati and Donald Kolobe.

SA's US$1-billion hydrogen economy fund

South Africa's plan to raise $1 billion to kickstart the country's hydrogen economy in partnership with Denmark and the Netherlands bodes well for a new energy future, says Dr Titus Mathe, CEO of the SANEDI, the South African National Energy Development Institute.

The announcement that Denmark and the Netherlands would join forces with South Africa to raise $1-billion was made at the business forum on green energy transition and green hydrogen partnership impact, recently held in Pretoria. The fact that Mark Rutte and Mette Frederiksen, the prime ministers of the Netherlands and Denmark respectively, attended the forum signalled the two countries' support for South Africa's energy-transition ambition.

This support is well placed when one considers the context South Africa has already created for a hydrogen economy. Apart from resource advantages – abundant renewable energy sources in the form of wind and solar, accessibility to sea water that can easily be desalinated to produce water for use in producing hydrogen using electrolysers, and the cobalt, nickel, platinum and other minerals required to produce and use hydrogen fuel cells and batteries – South Africa also has technical and knowledge advantages.

Chief among these is the country's well-developed expertise in the Fischer-Tropsch technology and the production of synthetic fuels, which are easily transferrable to green-hydrogen technology. As an energy carrier, hydrogen is already used in a wide range of applications in South Africa – albeit currently produced from fossil fuels – so safe storage and transport is well understood. The country has an established manufacturing sector and a vast labour force that is "completely trainable", in the words of our Green Hydrogen Commercialisation Strategy.

"All this means the country has the potential to decarbonise traditionally hard-to-abate sectors, such as heavy-duty transport, aviation and shipping, and industries such as steel, cement, and ammonia/fertiliser manufacturing," says SANEDI's Titus Mathe.

Acting on this potential, South Africa started investing in hydrogen research, development and innovation more than 12 years ago through a programme called Hydrogen South Africa (HySA). More than R500-million has since been invested in research and development activities, leading to SA-developed intellectual property such as membrane electrode assemblies and the integration of systems in the various sectors of the hydrogen economy. During the Covid-19 pandemic, for instance, South Africa powered a field hospital using hydrogen fuel cells that combined national and international intellectual property.

Over the past few months, Infrastructure SA, a programme within the Ministry of Public Works, has identified a pipeline of 19 green-hydrogen projects valued at more than R300-billion. The Industrial Development Corporation (IDC) also secured €23-million in grant funding from the German government to support the development of South Africa's green hydrogen economy and help to accelerate the country's transition to renewable energy.

Internationally speaking, the Carbon Border Adjustment Mechanism (CBAM) states that any product manufactured outside the European Union using so-called "dirty energy" will be subject to significant carbon tax.

Given that South Africa is a substantial exporter of products such as steel, cement and fertiliser, carbon neutrality and products produced using renewable energy and green-energy carriers will do much to secure and grow our export markets. The knock-on effect on these and other value chains will create considerable economic benefits, including job creation and mega-infrastructure development in underdeveloped areas.

From a domestic point of view, several policies are in place to support South Africa's participation in the hydrogen economy. These include the Department of Transport's Green Transport Strategy, the Department of Mineral Resources and Energy's Just Energy Transition (JET) Framework – which advances the production and use of hydrogen in the electricity sector – and the South African Renewable Energy Masterplan that encourages the use of green hydrogen.

In June 2021, the Minister of Trade, Industry and Competition established the Green Hydrogen (GH2) Commercialisation Panel, which is led by the IDC. The panel has private and public sector members and, drawing on the DSI's HySA programme and Hydrogen Society Road Map, has developed South Africa's Green Hydrogen Commercialisation Strategy and Action Plan, which was approved by Cabinet in 2022.

Policy, research, and development require implementation, which is where SANEDI comes to the fore. The announcement of Dutch and Danish support for the $1-billion fundraising effort aligns perfectly with SANEDI's five-year strategic plan and the current financial year's performance plan. The conditions of this collaboration must, however, be well understood before South Africa commits to a long-term plan.

In terms of the five-year plan, SANEDI will champion and drive the demonstration and introduction of innovative renewable energy solutions in South Africa, including cleaner fossil fuels and cleaner mobility. SANEDI furthermore supports the DSI's Energy Secretariat in managing research and development projects, with a strong focus on the hydrogen economy, The Institute is also establishing a knowledge base in collaboration with the *Deutsche Gesellschaft für Internationale Zusammenarbeit* (GIZ).

While the green-hydrogen future is bright, it would be foolish to ignore the challenges that must be managed. Green hydrogen is three to four times more expensive than grey hydrogen, which poses significant funding stumbling blocks, a challenge that is exacerbated by the need to repurpose resources and facilities that may be left stranded in the transition to a hydrogen economy.

In addition, South Africa needs to establish standards and norms that directly address large-scale hydrogen storage and transportation, including hydrogen pipeline infrastructure; the development of sufficient specialised skills and local manufacturing capacity and capabilities; providing certainty on intellectual property ownership; and overcoming electricity grid constraints.

"These are not small matters. However, given the groundwork that has already been done, local advantages that already exist, the willingness of the international community to support the development of South Africa's hydrogen economy and the immense benefits it could deliver, it is an opportunity that must be pursued wholeheartedly," concludes Mathe.

sanedi.org.za

Solar generation system **at ACTOM**

ACTOM recently gave the go-ahead for the first solar power generation system to be installed at the group's main factory complex at Knights, Germiston.

ACTOM MV Switchgear has completed the installation and commissioning of a grid-tied PV solar system that can generate around 1.0 MW of power at its Knights factory complex.

ACTOM's MV Switchgear is the largest consumer of power among the various manufacturing divisions at the Knights site and was therefore selected as the first division to be equipped with a solar generation system.

The solar installation at MV Switchgear, which went into operation in July this year after installation and commissioning was completed in June, is a grid-tied PV solar system that is designed to generate around 1.0 MW of power, which is approximately the division's power consumption at peak load and about 50% of the peak load drawn by all the factories on the Knights site.

"We expect the system to reduce the Knights site's power consumption from the national grid by up to 50%, which represents a significant cost saving for us," says Rhett Kelly, MV Switchgear's design and development manager.

"MV Switchgear's energy consumption, and thus its electricity bill, is expected to drop by up to 75%. This figure will naturally depend on the weather and the degree of operations carried out during night hours when the solar system is unable to generate power," he adds.

The system comprises two identical 550 kW grid-tied PV solar-powered inverter installations, which have been installed at the two major transformer locations in MV Switchgear's network, supplying power to various parts of its extensive factory. The solar panels are installed on the main factory roof and are linked to the inverters at these two transformer locations.

Each inverter station comprises five 110 kW inverters, an inverter collector box ,and a data management system. "Each inverter system is tied into the low voltage electrical installation of its respective main distribution board. If the power generated at the inverter station exceeds the power demand at its location, excess power generated is back-fed via the transformer into the Knights site 11 kV ring network and used to supplement the power demands at other locations on the site, thus ensuring that no PV generated power goes unused," says Rhett.

Johan Jordaan, MV Switchgear's Technology Development Specialist, explains further: "The system operates without battery backup and therefore requires a 50 Hz ac mains supply to support the load when inconsistent or no power can be generated from the solar panels due to overcast conditions or at night. By definition, a grid-tied solar generation system without battery storage cannot operate in isolation, its aim and purpose being to reduce the energy consumed from the grid."

For some time, the division has been well-equipped with diesel-powered generators as an alternative source of 50 Hz ac power from the grid, when load-shedding occurs, for example. "Here again, as with mains supply from the grid, our adoption of solar generated power provides us with the opportunity to reduce our dependence on expensive diesel power generation. We cannot do without it, but now, thanks to having brought solar generation into play, we require it less than previously and are able to achieve substantial energy cost savings as a result," Johan states.

ACTOM plans to progressively introduce solar generation systems to other factories on the Knights site, as well as at Group factories and workshops situated elsewhere in Gauteng and around the country.

www.actomswitchgear.co.za

Johan Jordaan: Solar generated power provides us with the opportunity to reduce our dependence on expensive diesel power generation. We require it less than previously and are able to achieve substantial energy cost savings as a result.

ABB invests in local MV switchgear manufacturing

To bring smart medium voltage (MV) switchgear closer to local customers while creating long-term job opportunities for engineering graduates, ABB has added the local manufacture of UniGear ZS1 medium voltage (MV) switchgear to its South African Longmeadow facility.

As part of ABB's strategic plans to strengthen local manufacturing, the company has invested over R10 million to complete additional technology transfer that brings the manufacture of UniGear ZS1 medium voltage (MV) switchgear to South Africa.

Previously, the product was fully imported from the Czech Republic or other countries when needed. Due to the investment, 60% to 70% of the technology will be locally manufactured and assembled. As a result, the company's customers will benefit from better design flexibility, faster accessibility, and decreased costs due to reduced import costs and shorter delivery times.

"The size of the South African switchgear market is projected to register growth. The increasing number of investments in sustainable power generation, coupled with the growing population, is expected to drive the growth of the market. This illustrates the importance of the domestic sector to multinationals and the strategic location of South Africa to a rapidly growing African consumer market," says Yunus Hoosen, Head of InvestSA, an agency of the Department of Trade, Industry, and Competition. ABB's Longmeadow campus in Modderfontein, Johannesburg spans 43 520 m2 and contains offices, manufacturing, and logistics centres. The upgraded Distribution Solutions factory on the campus where the UniGear ZS1 MV switchgear will be manufactured now employs around 120 people, ten of whom have been newly employed due to this investment.

ABB plans to increase these numbers by employing more permanent engineers, contractors, and graduates – for example, through its graduate programme, in which over 70 graduates are currently participating. In this way, ABB South Africa is playing its part by creating jobs in a country with one of the highest unemployment rates in the world.

In addition to the transfer of UniGear ZS1 production, the company has started the process of increasing the localisation of its Compact Secondary Substations (CSS), due to be completed in October 2023.

Egon Worthmann, MV primary air insulated switchgear (AIS) manager for ABB Electrification's Distribution Solutions division, says: "Utilities are increasingly looking to implement smart solutions to solve complex energy challenges. ABB is now well placed to continue to deliver world-class solutions to customers through local manufacturing right here in South Africa. The creation of job opportunities for local engineers and contractors demonstrates our commitment to the long-term development of the country."

Egon Worthmann, MV and primary AIS switchgear manager for ABB Electrification Distribution Solutions.

Yunus Hoosen head of InvestSA, an agency of South Africa's department of trade industry and competition.

With InvestSA's Yunus Hoosen, at the opening of the upgraded ABB Distribution Solutions factory where the UniGear ZS1 MV switchgear will be manufactured, are ABB graduates, from left: Momelezi Sifumba; Njabulo Mgaga; Glodia Mokemane; and Anela Made (far right).

Built in 2009, ABB South Africa's headquarters demonstrates the company's early adoption of more sustainable manufacturing approaches, with the site boasting a 760 kWp array of rooftop solar panels that generate enough solar energy to cover around 30% of the site's annual energy consumption of 2 400 MWh.

Says InvestSA's Yunus Hoosen: "The ABB investment further signifies that South Africa remains an attractive investment destination across all sectors, including the Advanced Manufacturing sector. InvestSA remains ready and committed to assist foreign and domestic investors in realising their investment in South Africa, more so with localisation a key part of economic reconstruction and recovery."

ABB's Distribution Solutions factory in the company's Longmeadow facility services customers in South Africa and other sub-Saharan countries.

www.abb.com

SA manufacturing opportunities **for SMEs**

Jeremy Lang, Chief Investment Officer at Business Partners Limited, discusses how small businesses (SMEs) can play a crucial role in driving the growth of the manufacturing sector.

Identified in the National Development Plan (NDP) as an industry poised for job creation and GDP growth, South Africa's manufacturing sector is one of several areas of interest. Despite several hurdles having thwarted the industry's progress over the past few years, efforts by the public and private sectors to revitalise and expand SA's manufacturing capabilities present an encouraging prospect for small- and medium-sized enterprises (SMEs).

Last year saw South Africa's manufacturing sector being put through its paces, with the industry's gross value showing a decline of 1.3% during the first six months of the year when compared to the same period in 2022. Persistent loadshedding, input cost pressures and the Durban floods during April dealt deafening blows to the sector's progress in several key performance areas.

The industry did, however, show signs of recovery during the latter part of 2022, with an almost 3.0% year-on-year increase in September. Despite predictions by analysts that factory output would remain subdued, factory production rose by just under 5.0% month-on-month over the same period. Recently, the Absa Purchasing Managers Index rose to 49.8 index points in April 2023 from 48.1 in March showing some signs of some recovery.

SMEs as vital cogs within the sector's growth engine

Jeremy Lang, Chief Investment Officer at Business Partners Limited says that, as sectors such as manufacturing seek to follow the country's renewed impetus towards economic recovery, a vital component of the solution lies with small businesses.

"Going forward, the strategic positioning of small businesses along the industry's supply and value chains will serve to unlock the sector's potential as a bolstered contributor to our country's GDP, socioeconomic development and the broadening of the fiscal base," he asserts.

Recent data presented by Stats SA saw South Africa's manufacturing sector taking its place as the second highest contributor to total turnover (25%), after trade. "Now is the ideal opportunity for local entrepreneurs to seek out and harness the opportunities that exist within the manufacturing space," says Lang, who encourages SME owners to look into sub-sectors such as agriculture, pharmaceuticals, renewable energy, and steel.

Opportunities within sub-sectors

A key example can be seen in the findings of a report by the Pan-African Investment and Research Services (PAIRS), which foregrounded the agro-processing sub-sector as one of the most crucial drivers of manufacturing. Opportunities for SMEs in this arena sit within areas such as processing, logistics, training and skills development, quality assurance, and machinery.

As Lang explains, for SMEs who wish to take advantage of emerging trends within these kinds of value chains, skills such as innovation, negotiation and collaboration will be significant determinants of enduring success.

It is also the ideal time to "pool our resources" and "optimise our existing strengths" as a country, Lang advises, referring to the fact that South Africa boasts some of the world's largest automotive production plants.

Given that the automotive industry is undergoing an unprecedented period of transformation, driven by the global call for sustainability, SMEs can now position themselves into this pivotal change process in areas such as the production of parts for electric vehicles and cleaner energy innovations.

Intercontinental prospects for local SMEs

Contributing to the Pan-African outlook on manufacturing and what it means for South African SMEs, Lang encourages entrepreneurs to set their sights on local prospects and those which lie within the African continent as a whole.

An important factor in the growth of the country's intercontinental manufacturing capabilities is the African Continental Free Trade Area (AfCFTA). As Lang argues, the AfCFTA can provide local manufacturers with the momentum they need to expand into other African territories.

The greatest challenges for SMEs looking to take advantage of more harmonious intra-Africa trade lie in skills shortages, transportation and the ailing state of South African infrastructure.

Considering the skills challenge, Lang encourages SMEs to seek support from the Business Partners' technical assistance and mentorship programme, which is sponsored by the Swiss State Secretariat for Economic Affairs (SECO). "Through our technical assistance programme, we contract expert consultants to assist business owners in navigating the challenges they face in their business journey and to close the skills gaps that may exist within a business."

Lang is also in full support of the recent launch of the NEF-Transnet SMME Fund for boosting localisation and South Africa's manufacturing capabilities. The five-year partnership between Transnet, the National Empowerment Fund, and the National Association of Automotive Component and Allied Manufacturers (Naacam) plans to integrate SMEs into its related value chains and is expected to invest around R220-million into the resurgence of the local manufacturing sector.

As Lang concludes: "South African SMEs need to tap into developments on the local front, where government has committed to promoting localisation and industrial diversification as part of its NDP targets.

As the future of the sector driven by policy reform begins to take shape, entrepreneurs should pay close attention to developments in industry, and consider how manufacturing can become a key to long-term success."

www.businesspartners.co.za

Massive 316 column for SA's petrochemical industry

Sassda member Kelvion Services recently manufactured a large stainless steel column for a local petrochemical company from ultra resilient, top-of-the-range 316 stainless steel. This challenging project stems from its decades-long, specialist supply of locally designed and manufactured heat exchangers, pressure vessels and cooling towers to the local industry.

Sassda member, Kelvion Services, recently completed a 4.0 m long stainless steel column with a diameter of 3.0 m and a total mass of 100 t.

In terms of the manufacture of the large stainless steel column, the fitment of internal tray rings and trays was completed in Kelvion's 14 863 m² Germiston-based workshop and represented 30% of the overall mass of the column.

The project took approximately eight months, and the team was under pressure to produce the complex piece of equipment to its normal world-class standards in a tight timeframe.

Explaining the complexities of the fabrication of the high-pressure piece of equipment, Kelvion MD Alex Dreyer says; "The 54 m long column had a diameter of 3.0 m, a sizeable length-to diameter-ratio, and a hefty total mass of 100 t, all of which were combined with the challenge of thin walls. This presented several handling issues in our works, and during transport."

The true scale of the project became clear when the completed column was transported, over 185 km and a total drive time of 14 hours, to site on steerable, self-levelling multi-axle trailers.

Depth of experience

Fortunately, the depth of Kelvion's experience and knowledge allowed it to complete the project successfully.

Kelvion Services started operations in South Africa in the 1970s as GEA Aircooled Systems, which was part of the German-based GEA Group.

Since the 1980s Kelvion has also supplied air-cooled heat exchangers, shell and tube heat exchangers, pressure vessels, plate heat exchangers, cooling towers, bulk air coolers, etc., to southern African industry.

"Initially Eskom was our main client and we supplied cooling towers, feedwater heaters and air-cooled condensers to a number of Eskom power stations, e.g., Matimba, Majuba, Tutuka, Arnot, Kendal, etc," explains Dreyer. More recently, the company supplied the air-cooled condenser for Eskom's Medupi power station.

In 2014/15 the GEA Group sold its GEA Heat Exchangers Group to a private equity investor and the South African GEA heat exchanger companies were renamed Kelvion Thermal Solutions (GEA Aircooled Systems) and Kelvion Services (formerly GEA Nilenca).

The two local entities, which were combined into a single operation, Kelvion Services, in 2018, also had access to the full range of products from the global Kelvion Group including heat recovery, heat exchangers, plate heat exchangers, and transformer oil coolers.

In-house technical experts

The company's key differentiators in the market are the unique services, technology, skills and products it offers and the fact that it has always employed in-house thermal design engineers, pressure vessel design engineers and welding engineers.

"This allows us to handle unusual customer requirements for unusual applications. Furthermore, we have access to the technical know-how of our sister companies all over the world," says Dreyer.

Looking to the future, in addition to the existing markets it serves, Kelvion is focused on developing several innovative products that will allow it to tap into new markets. These include:

- Datacentre cooling systems.
- Carbon capture applications.
- Hydrogen (production and distribution).
- Heat recovery systems.

Kelvion is a global leader in heat exchangers and related technologies, serving customers in more than 100 countries across a variety of industries. With a history dating back more than a century, the company is known for its innovative solutions and high-quality products that help customers optimise their processes and reduce energy consumption.

www.kelvion.com/za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Filter monitoring: a crucial component for energy-efficient operation

This article by Jürgen Arndt of WIKA outlines how continuous filter monitoring crucially influences the energy efficiency of a system and supports operators in complying with legal requirements.

In hydraulic circuits, increasing contamination of the filter element causes an increasing pressure drop.

If the careful use of energy resources used to be for cost reasons, today, increased environmental awareness plays a role, and is becoming mandatory thanks to legal requirements and the quality of the technology.

Whether with air filters in ventilation and air-conditioning systems or oil filters in hydraulic circuits, increasing contamination of the filter element causes an increasing pressure drop. To keep the flow of the medium (air or oil) constant, the fan or the pump must apply more power, so the energy consumption increases.

Filter monitoring signals the increasing pressure drop across a contaminated filter element. Replacing a fouled filter ensures the flow of the medium and thus prevents the energy consumption of the fan or the pump from increasing.

Legal bases

With the adoption of the Kyoto Protocol in 1997, the European Union committed to reducing CO_2 emissions. To reach this climate goal, in 2005 it adopted the EuP (Energy using Products) Directive. This was renamed the ErP Directive (Energy-related Products directive) – also known as the Eco-design directive, in 2009.

The directive aims to reduce energy use and other negative environmental impacts throughout the life cycle of products powered by electricity fossil or renewable fuels. The Directive means manufacturers must consider energy use and other environmental factors in product design and both manufacturers and importers are directly affected.

High resistance – high energy consumption

It is easy to understand that a contaminated filter element is more resistant to the flow of a medium than a new, clean element. Physically, the pressure in the filter inlet increases – which can be monitored very easily using a pressure measuring instrument – and this reduces the flow rate. Since the required flow is specified, more energy must be introduced to compensate for the restriction in the filter.

Energy-related vs cost-based considerations

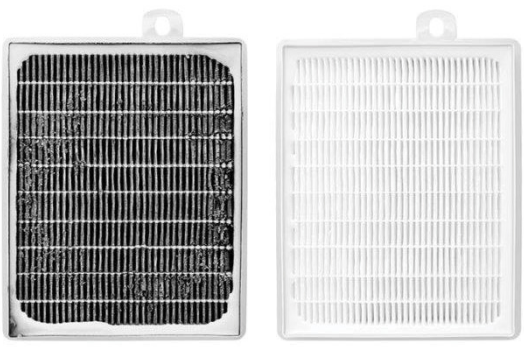
From an energy perspective, a lightly soiled filter should be replaced straight away. This conflicts with the fact that the exchange itself generates material and labour costs. In addition, the exchange can only take place in the absence of both pressure and flow, and thus the machine or the process must be stopped. Based on these considerations, it is also clear that an exchange after a fixed period of use, as we are familiar with during annual services on cars, for example, is not an optimal solution.

Cost elements for filter changes

- New filter element costs.
- Seals and sealing.
- Disposal of the old filter element.
- Maintenance hours.
- Production shutdown costs.

The compromise is to identify an acceptable level of contamination specified via a maximum allowable differential pressure across the filter. Normal limit values for the differential pressure (ΔP) of hydraulic filters are between 1.0 and 5.0 bar. In ventilation systems, the limit values are between 50 and 5 000 Pa (0.5 to 50 mbar).

Regular monitoring of the pressure drop saves on operating costs, since changing



A contaminated filter element is more resistant to flow than a new, clean element, so more energy must be introduced to compensate for the restriction in the filter.

out the filters only happens when the filter is close to reaching its accepted level of contamination. A further advantage is that through continuous monitoring and tracking, the filter replacement can be scheduled for the convenient and cost-effective shutdown time of the operational process.

In either case, the pressure drop across the filter is measured, that is, the change in pressure (ΔP) between the filter inlet and outlet. However, the pressure loss across the filter also increases with the volume flow.

The ΔP as an indicator of the contamination of the filter may therefore only be assessed in the defined operating state (average flow and temperature).

Filters for liquids can exceed the ΔP limit because of brief pressure peaks, for example. Due to inertia, however, these are not problematic issues for mechanical switches.

For sensors, however, it is advisable to provide for a short 'dead time' in the electronic control system to smooth out any transient measurements.

Filter monitoring in hydraulic circuits

The return filters in a hydraulic circuit are a special case. As the name suggests, these are in the return line, just before the oil flows back into the tank. There is ambient pressure (atmospheric pressure) in the tank. This means that ambient pressure is also present at the filter outlet. This simplifies monitoring since a differential pressure sensor can now take over the measuring task. This has a favourable effect on the costs of filter monitoring. First, differential pressure sensors are less expensive than ΔP sensor. Also, there is a saving on the need for a pressure line from the filter outlet to the low-pressure connection of the ΔP sensor.

In addition, temperature measurement of the oil is essential in hydraulic circuits. This enables the high viscosity of the hydraulic oil, which is still cold when starting, to be considered, thus avoiding false alerts.

The hydraulic oil temperature is also required to control the oil cooler. It has a significant influence on the time over which the oil is used.

$$\Delta P_{cold} = \frac{v_{cold}}{v_{warm}} \times \Delta P_{warm}$$

$v_{cold} = Start\ viscosity$
$v_{warm} = Operating\ viscosity$
$\Delta P_{cold} = Differential\ pressure\ at\ cold\ oil$
$\Delta P_{warm} = Differential\ presure\ at\ warm\ oil$

The formula for calculating excessive differential pressure due to the high viscosity of cold oil.

The trend in filter monitoring

From preventive maintenance to Industry 4.0 and IIoT cloud solutions, there is a demand for data everywhere. This can be seen clearly in the change from traditional measuring instruments with optical displays to electrical sensors with analogue or digital output signals.

When monitoring pressure filters, we see a trend to replace differential pressure sensors with gauge pressure sensors before and after the filter. This gives both the system pressure and the pressure at the outlet of the filter, which a differential pressure sensor does not offer.

The pressure drop, the difference between the two signals, is then calculated by the electronic controller, by the edge computer or in the cloud.

In addition to pressure sensors for filter monitoring, the WIKA portfolio covers all relevant measurement parameters that are necessary for controlling and regulating the operating states of a machine or system.

Further application examples can be found on our website in the 'Industries' pages.

www.wika.com/en-en/industries.

Five value pillars for mining digitalisation

Erik Pretorius, Global lead for large mining and mineral processing projects at ABB, talks about ABB's digitalisation roadmap, which the company aims to leverage alongside its physical and digital solutions to deliver value for customers navigating the complex digital solutions landscape.

Given the mountains of data generated by modern mining solutions, it is more important than ever to ensure digital transformation programmes have clarity, pace, and control. To help companies navigate this complex landscape and pursue programmes that deliver on value, ABB has developed a digitalisation roadmap that rests on value pillars.

ABB aims to leverage these pillars alongside its strengths as a provider of physical and digital solutions. The company works closely with everything from mining robots and trolley-assist systems to AI and augmented reality. ABB's vision is that automation, digitalisation, and electrification go hand in hand for digital transformation that can deliver real value from sustainable and efficient mining operations.

The five pillars – sustainability; asset performance; process performance; operational excellence; and a connected workforce – can be used to provide demonstratable evidence that digital transformation strategies are working. There is also a horizontal layer: cyber security, which is critical across all five pillars.

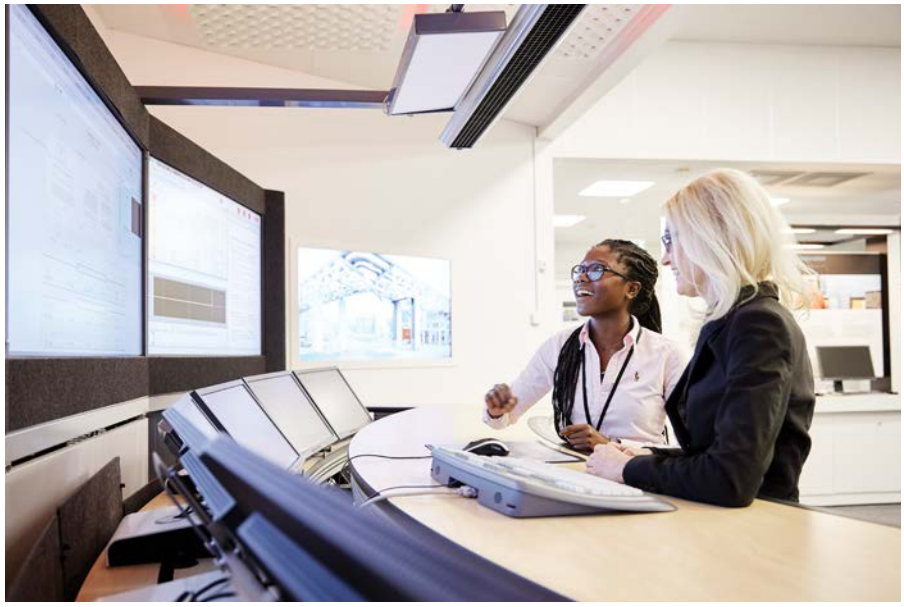
While the five pillars are based on long-held customer needs and the company's solutions and domain expertise, they also reflect massive changes in mining in recent years. Another important concept of digitalisation is to promote greater collaboration among different areas of the value chain. The value pillars must all be connected to maximise plant benefits.

As an example, predictive maintenance has a solid connection to the sustainability pillar and production. A reliability engineer, who needs to work closely with the production manager, may sometimes face a decision that involves running a piece of equipment close to a failure curve, even though that could result in higher energy consumption. In the end, for a holistic optimisation of the value chain, digitalisation needs to serve as a basis for collaborative working, instead of the traditional siloed way of operating.

Data integration is a critical part of progress in digitalisation. "With data, it is essential to remember that if we cannot measure, we cannot control. Advanced algorithms cannot make the right predictions if the basics are not right. For a complex and important project, such as cost reduction, we can dig into millions of data points, but it still needs to be correctly processed, ingested and managed to extract the right value from operations," says Pretorius. "Most of the time spent in data-driven projects is still around preparing the data correctly. That is a big hurdle, and mining is no different. Correct use of the technology associated with the right domain expertise is crucial to enable data integration and the five value pillars," he concludes.

go.abb/processautomation

ABB's vision is that automation, digitalisation, and electrification go hand in hand for digital transformation to deliver real value from sustainable and efficient mining operations.



ABB's five pillars of digitalisation – sustainability; asset performance; process performance; operational excellence; and a connected workforce – can be used to provide demonstratable evidence that digital transformation strategies are working.

Emerson to automate electrification of catalyst reactor

Global technology and software company Emerson has been chosen by Syzygy Plasmonics to automate its innovative catalyst reactor technology, which uses light instead of thermal energy.

Emerson has been chosen by Syzygy Plasmonics to automate its innovative catalyst reactor technology, which uses light instead of thermal energy for chemical manufacturing. The all-electric production method is designed to replace fossil fuel-based combustion, helping reduce industrial greenhouse gas emissions and operational costs while advancing global sustainability goals. Syzygy estimates its reactor systems could eliminate one gigaton of CO_2 emissions by 2040.

The Syzygy catalyst reactor technology will advance decarbonisation in a cost-effective way by electrifying carbon-intensive activities, such as chemical manufacturing, and reducing the carbon intensity of hydrogen, methanol and fuel production. Rather than rely on thermal energy, the Syzygy reactor harnesses the power of light to energise chemical reactions and reduce the carbon footprint in transportation fuels.

"We are excited to advance this opportunity with Emerson, not only for its automation technologies and software but also for its sustainability leadership and domain expertise in chemical engineering, electrification and hydrogen production," said Syzygy Chief Executive Officer Trevor Best. "As we expand beyond traditional paradigms of reactor technology and launch a new way to electrify chemical manufacturing, we want a technology partner who can help us scale our technology efficiently, safely and reliably."

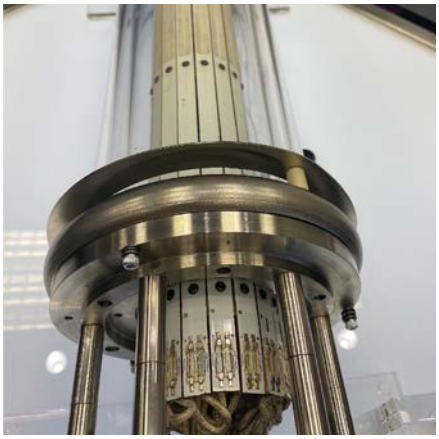
"Emerson is excited to collaborate with Syzygy Plasmonics on promising technology which could have a significant impact on industries that are among the most challenging to decarbonise," said Peter Zornio, chief technology officer at Emerson. "This aligns with Emerson's culture of innovation that takes on our customers' biggest challenges."

Syzygy has developed, scaled and integrated its core technologies, incubated at Rice University, into a universal photocatalytic reactor platform, which includes the Rigel™ photoreactor and the proprietary photocatalyst that enables light-driven chemical reactions at unprecedented efficiency.

For the Syzygy modular reactors, Emerson will provide hardware, software, and services, including its DeltaV™ distributed control system; industrial software for process simulation and data analytics; Rosemount instrumentation to measure pressure, temperature, level and flow; and Fisher™ valves to control pressure and improve safety.

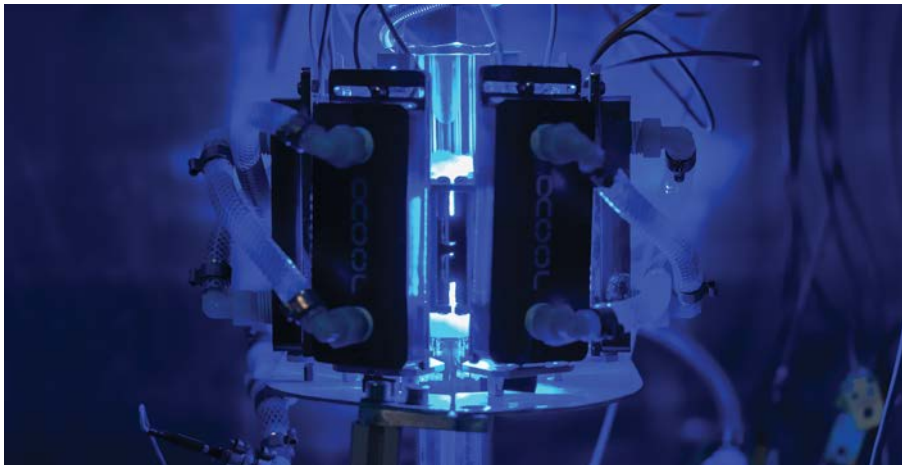
Syzygy has received funding from the US Department of Energy and the National Science Foundation and investments from Aramco Ventures, BP, Chevron Technology Ventures, Equinor Ventures, EVOK Innovations, Goose Capital, Horizons Ventures, LOTTE Chemical, LOTTE Fine Chemical, Pan American Energy, Sumitomo Corporation of Americas, The Engine, and Toyota Ventures.

Syzygy has three field trials planned for 2023. Leading global partners are driving strong market interest with trials located in North Carolina, California and South Korea. ❑



Syzygy Plasmonics' pioneering technology uses light to decarbonize chemical production, helping manufacturers reduce both emissions and operational costs.

Syzygy Plasmonics' co-founders sign an agreement with Emerson to automate the electrification of chemical production processes. Bottom row from left: Suman Khatiwada, Syzygy CTO; Trevor Best, Syzygy CEO; Mike Train, Emerson chief sustainability officer; Peter Zornio, Emerson CTO. Top row from left: Jim Cahill; Arif Mustafa; Mosta El-Haw; Liam Hurley; Denka Wangdi; Ben Chilton; LeEtta McDowell; Sean Hosseini, Puffer-Sweiven; and Carlos Garza, all members of the Emerson team.



Low-cost igus energy chain for unsupported applications

A new addition to the igus energy chain portfolio: the E4Q, a globally proven e-chain for applications with large unsupported lengths and high fill weight, now has a new L variant. Where the E4Q is too large, users can now save up to 20% with the new E4Q.64L, while still benefiting from the advantages such as quick and tool-free opening.

From the seventh robot axis in linear robot applications to machine tools, the igus E4Q-series energy chain has established itself in recent years in demanding applications with large unsupported lengths and high fill weights. There are two reasons for this. One is that the e-chain's wide side links and four stop-dogs per chain link make it very robust.

The other is that assembly time is reduced by up to 40%, because the crossbars can be opened in seconds, without tools and with just two fingers.

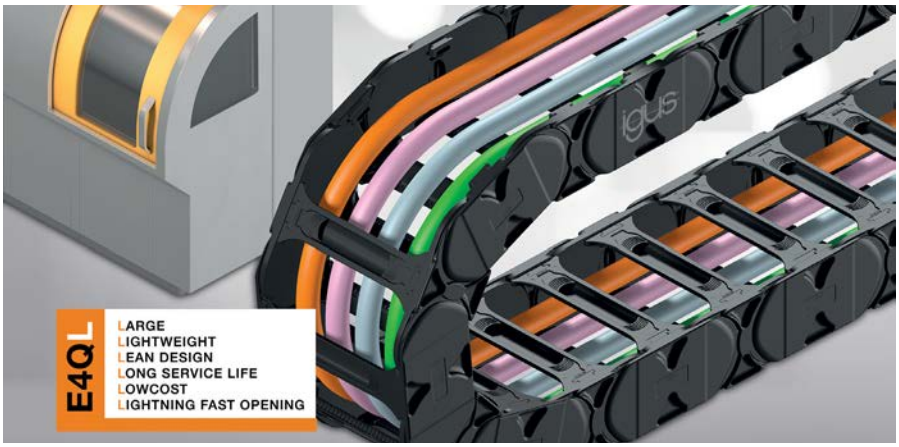
The problem is that, in applications with medium loads the E4Q is oversized. "To offer users the advantages of the E4Q in these applications as well, and at a lower price, we developed the E4Q.64L," says Christian Ziegler, head of e-chain product management at igus. "Depending on the width, the low-cost version of the energy chain costs between 15% and 20% less than the E4Q." he says.

To reduce costs, the side links are narrower than those of the E4Q, reducing the weight. The bionic design, which dispenses with any material that has no load-bearing function, was retained.

"The stop-dog system was completely rethought, resulting in improved service life than predecessors. The E4Q.64L is the first igus energy chain with three stop-dogs per chain link," says Ziegler. "This ensures an even more regular power flow and a longer service life."

Tests in the igus test laboratory prove that the E4Q.64L has an approximately 30% greater breaking moment than the 14240 series, which is also used for unsupported applications. This results in up to 20% more length with the same fill weight.

www.igus.co.za



The new E4Q.64L shines in applications with medium loads, such as machine tools, and features high strength, long service life and low weight.

The paper industry's environmental perception problem

According to the Two Sides Trend Tracker Survey 2023, which looks at consumer attitudes toward print, paper, paper-based packaging and tissue products, consumers continue to believe electronic communication is more sustainable, with 49% agreeing that the Internet or 'cloud' does not have a big environmental footprint, and 77% saying that electronic communication is more environmentally friendly,

The truth, however, is that paper and print products are among the lowest greenhouse gas emitters at 0.8% – this according to the European Environment Agency's Annual European Union Greenhouse Gas Inventory 1990-2018 – whereas the ICT industry accounts for more than 2.0 % of global greenhouse gas emissions, which is as much as all air traffic. If left unchecked, the ICT footprint could increase to 14 % of global emissions by 2040 [Ref: European Commission, 2020].

"The Trend Tracker 2023 survey looks at consumer perceptions on various topics relating to paper, print, paper packaging and tissue products and sustainability," says Jane Molony, executive director of the Paper Manufacturers Association of South Africa (PAMSA). This is the first time South Africa participated in the survey.

This extensive piece of research questioned more than 10 000 consumers in 16 countries across the world, from South America and the United States to South Africa and Europe, and provided an assessment of consumers' attitudes towards print and paper. Results of the 2023 study clearly show that while paper retains its place as a vital communication and packaging material, there are common misconceptions about the environmental impact of the paper and paper packaging industry.

"Few people understand that electronic devices have a significant footprint, from how they are made, to the way they are powered and disposed of," explains Molony. "In contrast, paper is a renewable material made from farmed trees, stores carbon and is recyclable." Despite this, 77% of South African consumers surveyed in the report think electronic communication is more environmentally friendly than paper communication, underlining ongoing misconceptions around the sustainability of both paper and electronic communications.

The pandemic also saw an upsurge in electronic communication with meetings, events and day-to-day business increasingly conducted online, and consumers relying more on online news and shopping.

"There is certainly a place for all types of communication, but we have to be careful about what we believe to be better for the environment," says Molony. "Electronic communication brings immediacy and convenience, but it is certainly not greener than paper and print." "Paper fares poorly as a means for communication, marketing and reading when it comes to environmental perceptions; however there is a contradiction in that people across all age groups agree or strongly agree that the forest industry plants more trees than are harvested," notes Molony. The research found that 63% of consumers are aware that the South African forestry industry plants new trees to replace those harvested every year and 71% agree that it is important to use paper products from sustainably managed forests.

SA's forestry industry has adopted a sustainable approach that ensures the trees it farms are well managed.

In fact, the South African forest industry plants some 850 000 trees per year, all of which are taking up carbon dioxide, storing it and releasing oxygen.

On whether planted forests are bad for the environment, 76% of respondents disagreed, yet an average 45% of respondents consider reading a magazine, newspaper or book on an electronic device to be more environmentally friendly than reading the same in print format (14%). "We know all too well that bad perceptions spread quicker and deeper, and last longer, than good stories, and this is the case for our industry," notes Molony.

"People are simply not aware of how wood for paper is sourced. South Africa's forestry industry has adopted a sustainable approach that ensures the trees it farms are well managed – from planting to harvesting and replanting, and in terms of water use and biodiversity conservation."

Paper recycling rates

Another common misconception about paper is the amount that is recycled. The survey found that only 19% of South African consumers understood that the paper recycling rate exceeds 60%. The survey showed that 42% of consumers believe that paper and paper packaging is wasteful. In reality, South Africa's overall paper recycling rate is currently 60.7%, with paper packaging even higher at 80%.

In 2022, a total of 1.25-million tonnes of paper was collected and recycled in South Africa. This is due to industry-led collection programmes, an extensive waste trade sector and conscientious citizens who separate their recyclables.

The survey also showed that less than 70% of consumers think only recycled paper should be used. "This is always an interesting myth to bust," says Molony. "All paper – at some point in the lifecycle – comes from wood, and while certain paper products like cardboard boxes can be recycled up to 25 times, paper fibres are not infinitely recyclable, and the pulp recipes will always need to be boosted by new, virgin fibre. Again, these come from sustainable sources."

"This report shows there remain many misconceptions surrounding the impact of print and paper-based products on the environment," concludes Molony. "Many consumers do not understand the sustainable nature of paper products. These misunderstandings make our work at PAMSA, and the campaigns at Two Sides and Love Paper, vital."

thepaperstory.co.za

Kamoa-Kakula power pack order for SEW-EURODRIVE

With well over 100 units already delivered, SEW-EURODRIVE in South Africa is set to continue supplying Ivanhoe Mines' prestigious Kamoa-Kakula Copper Complex in the DRC with a wide range of its X.e-series power packs.

According to Willem Strydom, Business Development at SEW-EURODRIVE, the power packs – which are integrated units comprising a gearbox, coupling and motor – will be part of Kamoa-Kakula's Phase 3 expansion. Since the mine's first phase of development over five years ago, SEW-EURODRIVE has worked closely with both Ivanhoe Mines and the engineering, procurement and construction (EPC) contractor.

"As in previous phases of the mine's development, our robust high quality power packs will provide reliable solutions for on-site applications such as conveyors, agitators and slurry pumps," says Strydom. "The size range in the order makes use of our wide capability range to provide a total solution, ranging from 55 kW units to 500 kW units." The latest order includes several X.e Series power packs for conveyor applications, planetary gearboxes for feeder applications and spare gearboxes. The equipment will be delivered in staggered shipments this year. While the mine typically undertakes the installation of the equipment, SEW-EURODRIVE sends technical teams to site to check final alignment and overall installation parameters.

"Our local assembly capability in our new facility in Johannesburg – combined with our ability to source from the group's other global operations – has allowed us to meet the tight delivery deadlines for this substantial order of equipment," he says. "Our global footprint and production capacity mean that we can deliver faster than most players in our field, and this is often an important factor for our market."

While the company previously imported the larger X.e Industrial gearboxes from Germany, it is now able to assemble these in the new South African facilities. As part of its service, SEW-EURODRIVE will also handle the logistics of getting this large volume of equipment to site. The company's training centre – the Drive Academy – in Johannesburg has also made a valuable contribution by providing training on the equipment and its maintenance.

www.sew-eurodrive.co.za

Engineered power packs from SEW-EURODRIVE for Ivanhoe Mines' Kamoa-Kakula Copper Complex.

New approvals for butterfly valves

The GEMÜ R480 Victoria series of butterfly valves now has US and European drinking water approvals.

The GEMÜ R480, R481, R487 and R488 butterfly valves now have an NSF/ANSI/CAN 61 certification and a DVGW (German Technical and Scientific Association for Gas and Water) certification. Both approvals certify that the products from the Ingelfingen-based valve specialist GEMÜ are suitable for use in drinking water applications. For GEMÜ R480, R481, R487 and R488 Victoria butterfly valves for drinking water applications, it is possible to select between the American NSF approval with the special function N and the European DVGW approval with the special function D. The NSF/ANSI/CAN 61 certification is also valid for all products supplied with liner code W in combination with stainless steel disc code A, B and D.

The DVGW certification is valid for all products with liner code W in combination with stainless steel disc code A, B and D and special function D. The composition of the seal in the GEMÜ 480 has been tested in accordance with the old Elastomer Guideline and the new KTW-BWGL standard. Following the publishing of the third change to the KTW-BWGL in March 2022, a transitional period is in place lasting until March 2025.

After this point, the old Elastomer Guideline will be withdrawn. With the GEMÜ R480 Victoria series, GEMÜ is able to provide its customers with security when planning future projects that will last beyond the specified transitional period and can supply suitable butterfly valves in the long-term.

www.gemu-group.com

Rand Air electrifies compressor fleet

Rand Air, South Africa's leading equipment rental company is investing in the new portable electric oil-free screw compressor, the PTE 900 VSD+. Rand Air Operations Manager, Craig Swart, explains that this machine is half the size of current electric air compressors in its range.

"Customers will now have a choice between an electric 900 and 1 500 CFM electric compressor, depending on their air requirements. Matching machine and application offers a much more efficient solution by minimising air wastage and reducing energy consumption."

Making the PTE 900 VSD+ even more efficient is the revolutionary Variable Speed Drive (VSD) technology, which automatically adjusts the motor speed to perfectly match air production to air demand in real time. The VSD+ drive train also ensures a low starting current.

The ISO 8573-1 (Class 0) PTE 900 VSD+ is ideal for avoiding the risk of end-product contamination. This includes the primary refinery market segment, along with the food and beverage, petrochemical and the electronic sectors. According to Swart, power stations are also moving to electric air compressors as they offer a much more efficient alternative to diesel machines, especially when considering the high cost of fuel.

www.randair.co.za

High performance additives for emergency generators

BMG has teamed up with Liqui Moly – a global leader in additives, motor, transmissions and hydraulic oils – to offer cost saving solutions to the local generator market. "As South Africa continues to face the exasperating challenges of daily load shedding and unplanned power outages, many companies are investing in alternative sources of power supply to maintain operations. Although emergency power generators are a popular choice to keep businesses running, the costs associated with running and maintaining these systems are often overlooked," states Carlo Beukes, Business Development Manager, Agricultural, Automotive and Lubrication divisions, BMG. "Generators often operate at low efficiency rates, resulting in exorbitant diesel consumption and a significant erosion of company profitability.

"There are many reasons generators have a high oil consumption at times, including the use of incorrect or poor-quality oil, which causes deposits to form on the piston and oil scraper rings that then seize. This means the crankcase chamber can no longer be sealed against the combustion chamber and as a result, fuel contaminates the oil that enters the combustion chamber where it is also burned.

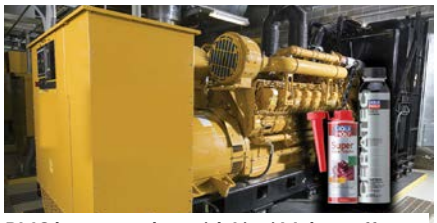
"Liqui Moly lubricants and additives, which have been specially developed to reduce wear and extend maintenance intervals, ensure generators function perfectly and remain operational at all times. The additional use of additives makes fuels more stable and more ignitable, achieving greater efficiency, particularly with lower fuel quality. In addition, the use of additives reduces pollutant emissions and fuel consumption. Additives in the fuel can also improve the cetane number, clean the system and keep it clean. This means that less fuel is needed and there are fewer defective parts. As a result, there is less generator downtime. In addition, Liqui Moly additives protect the entire fuel system from corrosion.

"BMG and Liqui Moly specialists have joined forces to offer the local generator market a dependable solution that yields major savings in generator running costs. The costs of diesel and maintenance for generators can amount to up to five times more than the cost of Eskom electricity.

"As an example, an average-sized generator can consume up to 60 litres of diesel per hour. Considering that load shedding cycles sometimes last for up to four hours and can occur three times a day, a single generator can easily consume 720 litres of diesel per day.

"Over the past three months, we have conducted accurate tests on-site at BMG World in Johannesburg. Results show a reduction in diesel consumption, ranging between 11% and 18% across the five generators used in the trial. When you consider the high daily volume of diesel consumed, these cost savings quickly accumulate. And by reducing diesel costs, a company's earnings are boosted significantly," Beukes suggests.

www.bmgworld.net



BMG has teamed up with Liqui Moly to offer substantial cost saving solutions to the local generator market.

The world's first offshore hydrogen production plant

Lhyfe, Europe's green and renewable hydrogen producer, has announced that Sealhyfe, the world's first offshore hydrogen production pilot, is now producing green hydrogen from a floating wind turbine in the Atlantic Ocean off Le Croisic on the West Coast of France.

Sealhyfe is now connected via a subsea hub to a floating wind turbine, proving the feasibility of producing hydrogen offshore under the toughest conditions.

After an initial phase of trials at quay, the Sealhyfe hydrogen production platform has now been connected to France's *Centrale Nantes*' SEM-REV offshore testing site, in the Atlantic 20 km off the French coastal town of Le Croisic. Sealhyfe is now connected via a subsea hub to a floating wind turbine, entering the second trial phase to prove the feasibility of producing hydrogen offshore under the toughest conditions.

This represents a historic step towards new clean energy based on the large-scale production of green hydrogen.

Designed to meet unprecedented challenges

At the outset of this project, Lhyfe wanted to prove the technical feasibility of producing hydrogen offshore and to acquire the operational experience needed to quickly scale up offshore production as a gamechanger in decarbonising the fuels needed for transportation and industry.

The company therefore voluntarily chose to expose Sealhyfe to the toughest conditions. It is being tested under real conditions on a floating platform, re-engineered from a WAVEGEM platform by GEPS Techno to stabilise the production unit at sea. The system is connected to *Centrale Nantes*' SEM-REV offshore testing hub operated by the OPEN-C Foundation, which is already linked to a floating wind turbine, FLOATGEN, engineered and operated by BW Ideol.

The Sealhyfe platform meets several key challenges, including:

- Performing all stages of hydrogen production at sea, ie, converting the electrical voltage from the floating wind turbine; pumping, desalinating and purifying the seawater; and breaking the water molecules via electrolysis to obtain renewable green hydrogen.
- Managing the effects on the system from the platform's motion at sea: listing, accelerations, swinging movements, and much more.
- Enduring environmental stress: Sealhyfe will have to survive premature ageing of its components as a result of corrosion, impacts, temperature variations, etc.
- Operating in an isolated environment: the platform must operate fully automatically, without the physical intervention of an operator, except for scheduled maintenance periods that have been optimally integrated from the design phase.

Lhyfe and its partners have designed, built, and assembled all the technology necessary for producing hydrogen offshore – including the 1.0 MW electrolyser supplied by Plug – in just 16 months. The Sealhyfe platform, which is less than 200 m^2, can produce up to 400 kg of hydrogen a day, which is approximately equivalent to generating 13.2 MWh/day of electricity.

By 2030-2035, offshore could represent an additional installed hydrogen generation capacity, equivalent to around 3.0 GW, for Lhyfe.

The eight months of on-quay trial

From September 2022 to May 2023, Sealhyfe was moored at the *Quai des Frégates*, in the Port of Saint-Nazaire. Lhyfe and its partners have thus been able to draw knowledge from a series of start-up tests to approach the second phase of the project with confidence, and to get the most out of the trials. Tests included:

- Benchmarking: Hundreds of tests were carried out at quay to record the precise behaviour and performance of the platform, so that they could be compared with the Phase 2 trial results via the thousands of sensors installed

By 2030-2035, offshore could represent an additional installed capacity of around 3 GW for Lhyfe.

on the platform.

- Technology and system optimisation: All the technology has been adapted to operate offshore in extreme conditions and designed to minimise the number of maintenance interventions required at sea. The tests performed at quay allowed Lhyfe to further optimise and improve the technology's behaviour.
- Development of key solutions: Lhyfe also developed the software and algorithm building blocks necessary to manage the site remotely. It will operate fully autonomously, more than 20 km off the coast while connected to the SEM-REV testing site's subsea hub.

Following this first phase, Lhyfe has already updated the specifications for all its sites – on- and offshore. All Lhyfe units will therefore benefit from the operating optimisations trialled under this experiment.

The start of offshore production

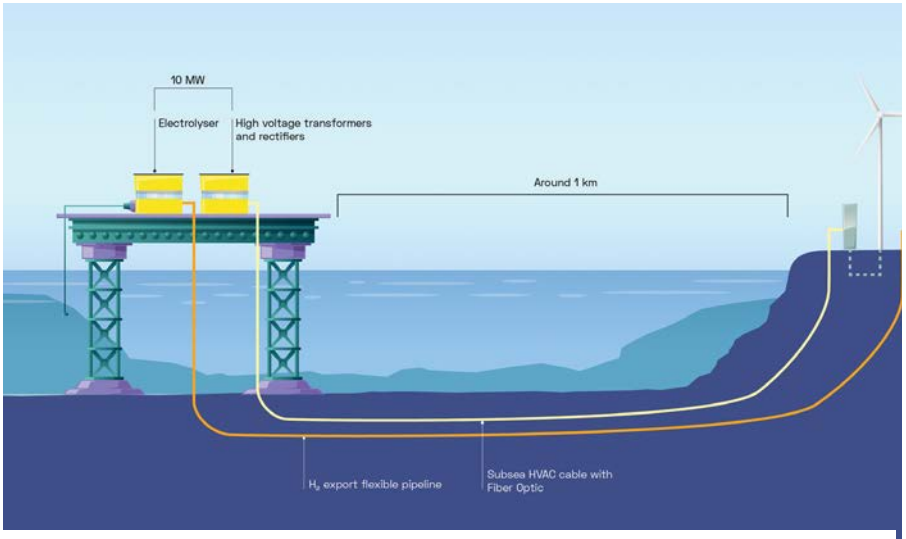
Sealhyfe was towed to its SEM-REV offshore testing site on 19 May. It was then connected to the site's subsea hub via a dedicated umbilical cable that was specially designed to produce hydrogen via an electrolyser. The system was restarted and on stream in just 48 hours.

Lhyfe will now reproduce all the tests carried out at quay several times to have a direct comparison of at-quay and offshore results. Offshore specific tests have also been added. In achieving reliable offshore production of hydrogen in an isolated environment, the company will develop a unique operating capability, which involves managing the platform's movement and environmental stresses, and validating green and renewable hydrogen production software and algorithms.

Next steps

As a logical follow-on to this first stage, Lhyfe recently announced that the HOPE project, which it is coordinating as part of a consortium of nine partners, has been selected by the European Commission under the European Clean Hydrogen Partnership and is being awarded a €20-million grant.

Sealhyfe moored at the Quai des Frégates, where Lhyfe and its partners undertook a series of start-up tests in preparation for the second phase of the project.



HOPE will be located in the North Sea, off the port of Ostend. 10 MW per day – up to 4.0 t of green H_2/day – will be produced at sea and then exported ashore via a composite pipeline to supply the needs of the regional ecosystem.

With HOPE, Lhyfe and its partners are aiming for commercialisation. This large-scale project (10 MW) will be able to produce up to 4.0 t a day of green hydrogen at sea, which will be exported ashore by pipeline, before being compressed and delivered to customers.

Through these two pioneering projects in offshore hydrogen production, Lhyfe aims to validate industrial solutions which it will submit in response to future calls for projects from various governments. This will help achieve the target of 10-million tonnes of clean hydrogen produced in the European Union by 2030, set by the European Commission as part of the REPowerEU plan.

Sealhyfe has had support from the French energy and environment agency ADEME and the *Pays de la Loire* Region, and Lhyfe has already signed partnership agreements with wind turbine developers and offshore power specialists, such as EDPR, Centrica and Capital Energy.

Says Matthieu Guesné, chairman, CEO and founder of Lhyfe: "At Lhyfe, we have only one aim: to leave a more breathable planet for our children. This is why we once again wanted to take up a major technological challenge: to prove – by producing hydrogen at sea for the first time – that it is possible to do it as of today. By paving the way for the mass production of renewable hydrogen at sea, Sealhyfe is fully in line with the EU's strategy to deploy an offshore hydrogen chain and wishes to help build energy sovereignty in many countries," he says.

Producing hydrogen using offshore wind turbines could give all countries with a coastline access to renewable green hydrogen, which would be produced locally, beyond the horizon line and in industrial quantities. Having taken on this offshore challenge, Lhyfe, has now proved it to be possible.

www.lhyfe.com

ACTOM unveils SBV4XE MV Switchgear

MV Switchgear, a division of ACTOM (Pty) Ltd and provider of innovative electrical solutions, has announced the launch of its SBV4XE switchgear, which incorporates a wide range of modern features for the delivery of superior performance, functionality, and cost savings.

Since the early 1990s, the SBV4 and later the SBV4E withdrawable pattern switchgear ranges have been widely acclaimed in Southern Africa for their low profile, compactness, robustness, and adaptability, making them ideal for applications with limited space constraints. Building on these features, MV Switchgear embarked on developing the SBV4XE to further enhance the switchgear's capabilities.

Rhett Kelly, MV Switchgear's Design and Development manager, says: "In developing the SBV4XE, we sought to retain the outstanding features of our previous models while introducing a host of significant improvements. Drawing on our extensive experience, spanning 50 years, in switchgear manufacturing we have reimagined the SBV4E product, incorporating advanced technologies and cost-effective solutions." These include:

- Enhanced mechanisms: The spring and cam follower mechanisms have been redesigned to use alternative materials, reducing costs without compromising reliability.
- Efficient operations: The opening and closing releases require less energy, resulting in improved energy efficiency compared to previous SBV models.
- Reduced maintenance: With a lower parts count, the circuit breaker operating mechanism requires less maintenance, leading to reduced overall ownership costs.
- Cost-competitive assembly: The vacuum interrupter pole assembly is more cost-competitive, ensuring affordability without sacrificing quality.
- Emission reduction: Arc cooling pressure relief devices have been integrated into the housing assembly, mitigating emissions during internal arc faults.
- Optimised manufacturing: The housing assembly is now bolted and riveted, instead of welded, streamlining production and offering inherent corrosion resistance.
- Lightweight and durable: Most components are manufactured using aluminium and zinc-coated steel sheeting, providing corrosion resistance, and enhanced galvanic bonding properties.
- Improved circuit breaker carriage: The redesigned carriage features a swivel-wheel chassis, allowing for 360-degree rotation and effortless manoeuvrability outside the housing assembly.
- Enhanced gears: The circuit breaker mechanism gears combine polymeric and steel materials, resulting in an 80% reduction in steel usage compared to traditional gears.
- User-friendly design: The circuit breaker carriage latching, interlocking, and racking mechanism has been redesigned to enhance ease of operation, simplicity, and functionality.
- Advanced current transformers: The ring bar and base current transformers (CTs) use epoxy resin insulation with an earth-screened bar primary and toroidal core or ring-type CTs.

Donovan Stevens, ACTOM Switchgear Division CEO, says: "The SBV4XE represents a significant leap forward in switchgear technology. Its innovative features and cost-saving enhancements offer our customers unparalleled value, reliability, and ease of use. We are excited to introduce this groundbreaking solution to the market."

Mervyn Naidoo, Group CEO of ACTOM, adds: "At ACTOM, we are committed to delivering cutting-edge electrical solutions that address the evolving needs of our customers.

The SBV4XE is testament to our dedication to innovation and excellence, and we are confident it will set new benchmarks in the industry."

www.actomswitchgear.co.za

The SBV4XE represents a significant leap forward in switchgear technology.

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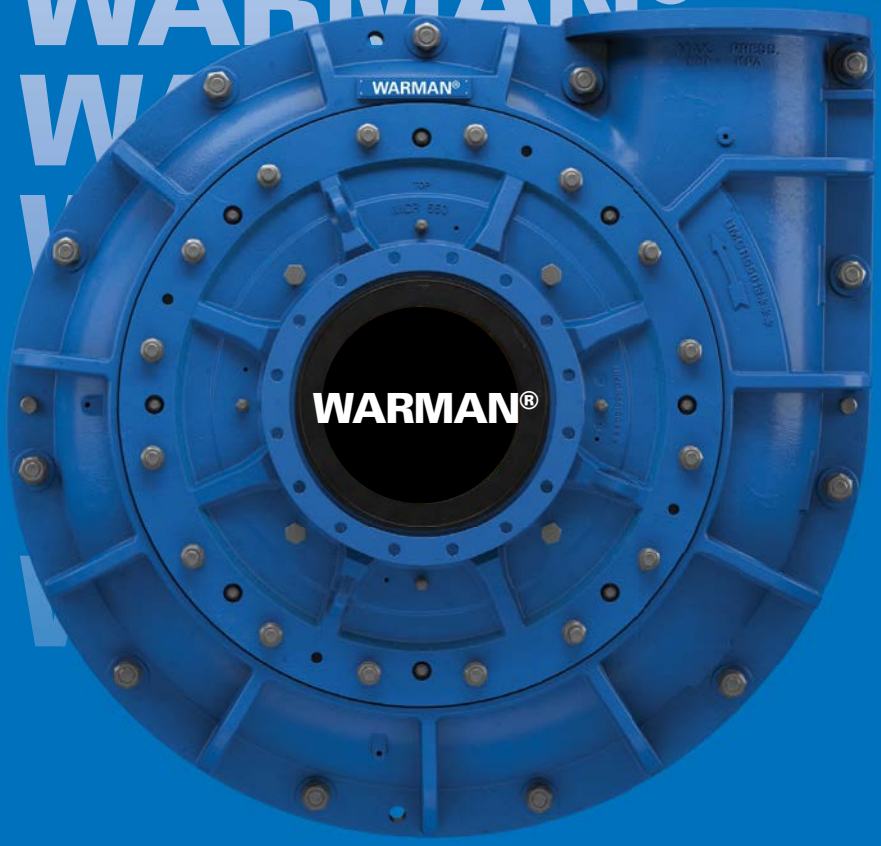

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